

Two Studies

by

Fr. Alverdes

Social Life in the Animal World (1927)

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Animal World**

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By
FR. ALVERDES

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Translated by
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I wish to express my very grateful thanks to my friend Professor E. W. Patchett, for his invaluable help and advice in the work of translation.

K. C. CREASY.

PREFACE

THE aim of this essay is to present a particular chapter of Animal Sociology, in accordance with the most recent results of research in zoology and the psychology of animals. Animal Sociology has an important bearing upon Human Sociology ; for much that from an isolated standpoint seems to us purely human proves, in the light of animal and comparative sociology, to be typical of group psychology in general.

The subject is divided into Special and General Animal Sociology. So far as I am aware, a comprehensive survey of the latter is here attempted for the first time. In the special section, also, I believe that I frequently proceed along new lines. In the final chapter Human Sociology regarded from a biological standpoint receives such discussion as the present state of comparative sociology permits.

F. A.

SOCIAL LIFE IN THE ANIMAL WORLD

I INTRODUCTION

Animal Sociology, or the study of the social life of animals, has already occupied the attention of a number of writers. Espinas was the first to write a comprehensive treatise on this subject ; others followed him, among them Doflein, Ziegler, and Deegener. One portion of the field has been particularly well surveyed, that, namely, which contains the so-called state-forming insects (bees, ants, termites, etc.), and excellent monographs have been written about them by Buttel-Reepen, Escherich, Forel, Wheeler, and others. But the scattered details of our knowledge of the social life of other animals have been much less carefully collated. Here, then, there is a gap to be filled.

Animal sociology has an important bearing on human sociology. As I have already mentioned in the preface, much that seems to us purely human, in the light of animal sociology comes to be recognized as typical of social psychology in general. The present treatise, however, is in no way concerned to show in how far much that we would call human is likewise found in animals, nor how much that we would call animal occurs in the behaviour of man (" Animal " as used here and later has, needless to say, no derogatory implications.) Nevertheless, one of the

intentions of this essay is to show in what respects the social life of men differs from, and in what respects it resembles, that of animals. Comparison of the two will then enable us to discover some of the basic instincts and impulses upon which the whole edifice of human society is reared. Researches such as these will form the task of a comparative sociology of the future, and it is one of the main objects of this work to collect the building stones for such a science.

A distinction can be drawn between special and general animal sociology. The former is concerned with the different types of social unit, such as the herd, marriage, the family, and so on, while the task of the latter is to study those general features which appear whenever any association is formed, such as the establishment of a social scale, mutual understanding, mutual assistance, etc.

While going through the literature of zoology from this particular point of view, I realized how defective in many ways our knowledge still remains. It is true that the subject itself frequently offers very great difficulties. Lying in wait for chances of observing the social life of the untamed denizens of the woods, or the fish in the mountain stream, requires much time and an ungrudging devotion to truth. Numerous investigators have undertaken such tasks ; but much remains to be done, and all those who come into contact with animals : farmers, explorers, sportsmen, keepers, and every animal lover, can lend valuable aid provided their observations are judiciously made.

For my present purpose I have endeavoured to pay special attention to all the most recent literature bearing upon the subject. In addition, Brehm's work on the *Life*

of Animals was, naturally, a rich mine of information ; I have made use of the fourth edition, edited by zur Strassen, except where otherwise stated. I have also read a number of travel books for the sake of what they might contain of interest for animal sociology ; among these I should like to single out that of von Schilling's, which, for this, as for other purposes, has much to offer. Other books of travel, which I will not name and have not quoted, often suffered from the fact that the author thought it necessary to assume a humorous tone whenever he was talking of animals or natives. This procedure (which, as a rule, merely screens the fact that the author has no positive contribution to make) rendered the works in question useless for my purpose ; for jokes, if we try to read a serious meaning into them, often admit of so many interpretations that it is impossible even to read between the lines.

The work of Köhler on anthropoid apes, and that of Schjelderup-Ebbe on domestic fowl and wild ducks, proved to be of the greatest importance for the chapter on general animal sociology ; these investigations open up new paths along which animal sociology may hope for great achievements. With regard to the exposition and interpretation of facts, I sometimes differ not a little from earlier workers in the field (especially Espinas and Deegener) ; but I have done my best not to dwell upon these points of difference so that mere controversy may not bulk too largely in the following pages.

I have limited my theme in this work by confining my treatment of animal sociology to the consideration of those social creations in which animal psychology (i.e. a specific

social instinct) is the essential factor. Thus I have not discussed the phenomena of symbiosis, synoikia, parasitism, mimicry, hive-formation ; although I do not pretend that animal psychology plays absolutely no part in them. For information on these heads I refer to Balss, Buchner, Jordan, Jacobi, Doflein, etc.

Within the various agglomerations which animals are capable of forming, a distinction must be drawn between associations (mere collections) and societies (organic wholes). By associations I understand those chance gatherings produced solely by external factors (e.g. insects round a source of light). Societies, on the other hand, are genuine communities which exist in virtue of some particular social instinct in the animals concerned (e.g. the ant-state, a horde of monkeys). In short, no social instinct, no society ! (My definitions here differ from those of Deegener.) In the formation of an association the individual is guided by environmental factors, and not by other members of its own species ; a society, on the other hand, is formed when the individual is guided in the first place by the presence of others of its own species and only in the second place by environmental factors. In a genuine society, should need arise, the individual members will exchange a favourable environment for one less favourable, solely in order to satisfy a craving for companionship, and to remain in contact with other individuals.

Thus the social species among animals are those whose individual members possess a social instinct, while the solitary species are characterized by a lack of this instinct.

Whenever social beings are united by chance into an association (fowls in a fowl-run, school children in a class, recruits in a squad), manifold relations are quickly established, and the association becomes a society. Solitary beings, on the contrary, can only form associations, although on certain occasions a social instinct may be awakened within a solitary species and an association be thereby raised for a time to the level of a society (see below). Solitary life is certainly the more primitive manner of existence; it is characteristic of all the lower forms of animal life, whereas societies are found only among the most highly developed species (cuttle-fish, insects, crabs, vertebrates). Social life, therefore, presupposes that mind and brain structure have both reached a certain level of development.

The question, which is the older, the family or the herd (the group, the society), and whether, perhaps, the one derives from the other, has long occupied sociologists. This statement of the question, as I shall show in detail, is altogether wrong; the phylogenetic point of view is worthy of all respect, but it is possible to concede too much to it. For the genesis, on the one hand of mateship and the family, and on the other of the herd, depend upon two distinct principles, each of which has its own biological significance. These institutions cannot be derived from one another; they stand side by side, and, among animals, sometimes they support and at other times they exclude one another. The situation is further complicated by the fact that marriage and the family obviously do not depend only upon the reproductive and the brooding instincts; an additional element may be involved, namely a special

instinct for mateship and for family companionship. This is proved by the case of those animals which propagate only during a special period of each year, and which yet live all their lives in company with their mates ; or whose family life is prolonged far beyond the time required to rear the young.

It may be stated at the outset that sexual relations among animals realize every conceivable possibility. Monogamy, polyandry, polygyny, whether mating be seasonal or permanent, are all to be found. Polyandry, however, is rare. Promiscuity also occurs ; it may be defined as that social state in which both male and female have intercourse with any number of individuals of the opposite sex taken at random. A distinction must be drawn between promiscuity as the normal state, and promiscuity as an accessory phenomenon. Given the second sense, then the existence of one or other of the two most common forms of mating (monogamy or polygyny) is the rule with the species in question, and only incidentally does one or other, or do both of the mates permit themselves to be unfaithful. Incidental promiscuity is by no means uncommon among animals (nor among human beings). But promiscuity as the normal relation of male to female, which would absolutely preclude any form of permanent mateship, is, on the other hand, by no means of such frequent occurrence among animals as some sociologists would have us believe. (Among human beings promiscuity is never the normal sex relation.) The permanent mateship of male and female is, nevertheless, a form of companionship which occurs only among the higher animals. I have consistently avoided the term

"polygamy" since it is so often understood to cover not only polyandry and polygyny, but, by some, promiscuity as well.

The term "instinct" has already been employed more than once in the preceding pages, and this is a suitable opportunity on which to explain briefly in what sense the term will be used in this book. As I have already dealt with this concept in a separate paper (1924) I shall now only add a few supplementary statements. Many writers speak of the instinctive and intelligent actions of men and animals as though these two types of action differed fundamentally from one another. As against this view, it must be asserted that a large instinctive element enters into every form of intellectual activity; whilst no instinctive action ever runs its course altogether automatically and mechanically, but always contains in addition to its fixed and unchanging components a variable element more or less adapted to the particular situation.

Every act, A , is, therefore, at one and the same time a function of a constant, C , and a variable, V ; expressed as a formula this becomes $A = f(C, V)$. The constant is the instinctive element in the actions of men and animals; the variable, on the other hand, is the element which produces in some cases an appropriate, in others an unforeseeable response to a situation. It must, of course, be emphasized that the analysis of the action A into the components V and C is a purely abstract analysis. V and C must not be taken as two more or less opposed natural agencies (as it were two souls) pulling the organism, now in this direction now in that, as they battle for supremacy; they

are merely symbols for two different aspects of the same reality. The difference between instinctive and intellectual activity is this, that in the former the constant, in the latter the variable predominates. In instinctive action then C is greater than V ($C > V$), in intelligent action C is less than V ($C < V$).

The purely instinctive, impulsive element in both instinctive and intelligent action is called the constant, for what is instinctive in every individual is determined by heredity. Neither animal nor man can transcend the limits of his native store of instincts. It is not alone the type of instinct which, for example, impels the insect larva just before the chrysalis stage to spin a complicated cocoon, characteristically different for each species, that justifies us in speaking of a constant. We have the same right to speak of a constant in the instinctive actions of the higher animals and man ; it is sufficient merely to mention those actions which are prompted by sexual and parental love, by the social and the egoistic instincts. But in a wider sense whatever man or animal does or leaves undone, has its roots in instinct, in impulse ; whatever is not potentially existent in this constant subsoil no power on earth can charm into being.

The variable factor contained in every act is most clearly visible in certain features of the behaviour of the higher vertebrates. Practice, experience, habit, also on occasion tradition—in short the whole past life of the individual—can greatly modify the course of subsequent behaviour. The reason is that in the intelligent activity of the higher animals $V > C$, whereas in any typical instinctive activity

of insects, etc., $V < C$. In intelligent actions the variable produces on the one hand the suiting of the action to the given situation, and on the other hand its imprevisibility.

We have to postulate the existence of a variable not only in the intelligent actions of the higher vertebrates, but also throughout the whole of their instinctive activities. Take the case of a bird building a nest; the variable appears in the way in which the individual bird sets about finding a suitable nesting place, and then, by means of purposeful and co-ordinated bodily movements, collects blades of grass, twigs, and floating feathers, and weaves them fittingly into the structure of the nest. This variable shows itself further in the greater skill displayed by the older birds in building. The acts performed in the operation of nest-building are by no means automatic, they are not mere "reflexes"; neither are they purely intellectual (where V would be greater than C). On the contrary, genuine instinctive acts, in which $C > V$ are everywhere involved. The fundamental impulse, C , invariably forms the constant basis which gives its "biological meaning" to the animal's whole procedure, and it is upon this foundation that all those individual purposive activities, which are determined by the variable V , repose. Exactly the same is true of the instinctive activities of insects, spiders, and so forth; however rigidly and unalterably these may appear to proceed, in every case $A = f(V, C)$.

In the majority of human actions $V > C$. But in the purely instinctive acts of insects, which are frequently executed with "intuitive" "somnambulistic" certainty without either practice or pattern, C often greatly

preponderates. It is this that frequently renders the actions of insects incomprehensible to human beings. For much that in man is ruled by tradition and can be performed by the individual only after long practice, in animals is conditioned by instinct, and faultlessly executed at the first attempt. But we are, of course, still far from being able to say in each particular case of animal activity that here tradition (founded on V) is at work, and there instinct (K). This problem opens up a very wide field for future investigation.

The notion of instinct defies all attempt to explain it; for instinct, in common with other psychic attributes, came to be possessed by organisms in the same way as did their individual organs. Instinct is, so to speak, the "directions for the use of" the various organs. Why should the possession of directions for use be more mysterious, more inexplicable, than the possession of the tool to be used? Instinct and organ are equally unexplainable.

In ordinary speech intellectual activity is called "conscious", instinctive activity "unconscious". On this point we must remark, however, that every act of man is attended with some degree of consciousness. This degree does not depend upon the relative amounts of V and C. It is just those acquired automatisms, which have nothing to do with genuinely instinctive acts (the daily winding up of one's watch, dressing and undressing) that are least consciously performed. As to the real nature of the consciousness of animals, we know nothing and can learn nothing.

Taking as our basis the formula $A = f(V, C)$, we realize that in human resolves, even in extreme cases, "emotional"

and "rational" are not antitheses. C and V are involved in both, only in the first we have $C > V$, in the last $V > C$. For even a "rational" judgment depends largely upon the "emotional" organization and the mood of the moment; its roots descend into depths beyond our penetration. On the other hand, in an action prompted purely by "feeling"—or by intuition—much is conditioned by the given situation and the given moment of time, and manifold experiences are interwoven with the "feeling".

We are notoriously prone to give *post factum* a rational "explanation" of our impulses to act; but these ultimately spring from the depths of the unknown and the unfathomable. That we so easily succeed in our "explanations" is due to our far-reaching adaptation to our environment (which we share with every organism); and we rarely become conscious of how many interpretations may usually be put upon our acts, nor of how easily we could find a whole bundle of motives for any one of them.

Because instincts are so restricted, so tied down, so limited in their scope, many irrational situations arise in the instinctive life of animals and man. We never, for instance, see ants, those wonderful architects, erecting a structure, however low, even when by this means they could bring within their reach an otherwise unattainable source of food. They try on the contrary every other method, only in the end to abandon their efforts if these are consistently unsuccessful. In the same way we see that although as social animals they are constantly assisting one another in all sorts of situations, ants never help each other to remove mites and other parasites from the surface of their bodies;

this is left for each individual to do for itself, and in consequence many a parasite is left undestroyed. It would, of course, be easy to exterminate them entirely if the ants helped one another with the business.

Speaking quite generally, irrational situations arise whenever two instincts, which were they combined would produce a purposive whole (the permanent advantage of the individual or the species), remain independent of each other. But irrational situations also arise whenever two instincts, acting independently of each other, cause the individual to react in contradictory ways towards one and the same object. This can be observed not only in animals, but notoriously also in the case of human beings. In fact, absolute purposiveness is not found in any organism.

At the conclusion of this introduction let me mention, and dispose of a peculiar kind of error, namely that animals as opposed to men enjoy complete liberty of action, and therefore live in a paradise of untrammelled freedom. In sexual matters particularly an idyllic unconstrainedness is supposed to reign. The catchword of a romantic primitive condition has in this, as in other connexions, obtained widespread currency. All such talk is, however, founded upon fancy unsupported by fact. Some historian might find it a profitable task to investigate the origins of these and similar fantastic notions.

Primitive man, just as much as civilized man, has his own strong inward and outward ties and inhibitions beyond which he cannot go (Thurnwald) ; and the behaviour of an animal is determined in exactly the same way by the inner and outer restraints which are imposed upon it. Whosoever

believes that sexual inhibitions do not exist for animals is on the wrong road altogether. Ideas such as these are frequently the result of observations carried out as occasion serves on apes and lions imprisoned in the cages of zoological gardens (cf. also Brehm, vol. xiii, p. 436). But is it permissible to draw conclusions applicable to the whole animal kingdom from the behaviour of a few separate individuals suffering more or less from claustrophobia? In other cases an observer is misled by watching the ways of dogs and other domestic animals, who, as a result of their association with human beings, have totally abandoned their normal social and sexual behaviour. Again, certain occurrences are wrongly interpreted, and a conclusion drawn from the behaviour of an animal in a single instance is applied in the first place to its behaviour in general, then to that of every animal of the same species, and afterwards, if possible, to animals in general.

The common notion that inhibitions first appear when the human stage in evolution is reached, and that they distinguish man from the "brute", is without foundation. The specific characteristics of man are found in quite other spheres. "Brutes" in the evil and derogatory sense exist only in imagination, not in fact. Men are fond of calling "brutes" those animals which, when trapped or hard pressed, turn and defend themselves. But "brutes" in the sense intended do not exist; what we do find are animals which act with great vigour both when defending themselves and in the pursuit of prey.

II ASSOCIATIONS

An association is formed by environmental factors causing a number of animals, whether of the same or of different species, to gather together in one place ; the mere presence of other animals does not keep the individual at the place in question ; it is, therefore, some factor in the environment which acts as the binding force. The aggregations of protozoa and small crustaceans which, under certain conditions, people in countless multitudes both fresh and salt water, are instances of associations ; so also are the collections of plant lice where the bond is merely a suitable feeding ground and not a social instinct. The gathering of birds and beasts of prey round the fallen body of a large wild animal in the tropics is an association, not a society ; as also are the gatherings of many species round a watering place in dry districts.

Groups of burying beetles (*Necrophorus*) gathered round the corpses of mice, lizards, birds, etc., are to be classed as associations. These beetles, alone or together, bury the dead body without themselves consuming any appreciable amount of it ; afterwards, however, it is invariably only a single pair of burying beetles that lays eggs therein, while the helpers, having done their work, withdraw ; thus the decaying corpse serves almost exclusively for the nourishment of the young which later emerge (Deegener, 1918,

p. 302). In burying beetles the burying instinct is invariably awakened by the sight of a corpse, whether the individual is alone or whether others are present ; each individual thereupon scrapes away at the task on its own account without any kind of mutual understanding with its fellow labourers. The effect of this instinct, which serves no useful purpose for the individual, but only for the offspring of the pair laying their eggs in the corpse, is of great importance in the preservation of the species.

Collections of ciliated infusoria at favourable points in their environment are further instances of associations. The slipper animalcule (*Paramæcium caudatum*) reacts positively to certain concentrations of CO_2 in water (Jennings, p. 100) ; the biological importance of this reaction is that it guides the *Paramæcia* to the aggregations of the bacteria which form their chief nourishment. Now *Paramæcia* themselves produce CO_2 ; it follows that in time ever-increasing "spontaneous collections" are formed where several *Paramæcia* have chanced to collect. There is, therefore, no question of a social instinct which brings *Paramæcia* together into one place, as used to be supposed. The mode of formation of this particular association gains interest from the fact that we have here an association formed, so to speak, in a self-created milieu.

A still further instance of associations is provided by the troops of migrating lemmings in the "lemming years". The (probably unmated) males travel alone, each independently of all the others ; the female seldom migrates (Brehm, vol. xi, p. 265) ; only when a large number are migrating, or when external obstacles act as dams, do

we get the impression of a gathering possessing the characteristics of a herd. The direction of the migration is determined by the given environment, so that, as a general rule, all the individuals travel in the same direction, even in different years.

III REPRODUCTION AMONG SOLITARY ANIMALS

The particular instinct which causes the members of social species to attach themselves to their own kind, or in the absence of these, to other animals, is wanting in the solitary species. Most of the lower animals lead a solitary life. If we disregard certain phenomena shortly to be mentioned, solitary animals never seek out other individuals. Speaking generally they exist, each one for itself, in extreme isolation, even when external conditions throw them together in no matter how great a number. Only at breeding time can we say that exceptions occur, in that the male and female then come together during the one sexual act, only to separate again immediately afterwards. In those species, however, where the fertilization of the eggs takes place without copulation there is not even an attempt on the part of male and female to come together.

Fertilization of the eggs without copulation on the part of the parents, that is to say without one particular male coming into actual physical contact with one particular female, occurs among many of the lower solitary animals; it occurs among numerous Coelenterata and ringworms, among the lower snails and the majority of marine shellfish, among *Echinodermata*, *Tunicata*, and many fishes (Meisenheimer, pp. 110-12). Eggs and sperm-cells are emitted into the water, and there fertilization follows. This emission takes place either without regard to the presence or absence

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of the other sex, or else individual members of the same species collect together beforehand in associations at definite places. In the latter case, whenever an individual discharges its sex substances this acts as a stimulus to the others, male and female alike. In many other species the male emits its sex substances into the water, and the sperm then penetrates into the female genitalia. In all these cases where a particular male does not enter into any direct relation with the female there can be no suggestion of the formation of a mateship.

Among the solitary species in which pairing and copulation occur, the individual may perform the sexual act either only once in its life, or repeatedly. The majority of insects pair only once (e.g. day-flies) ; spiders and some insects of the beetle, plant-louse, fly and butterfly classes, pair, as a rule, more than once. In general these repeated pairings take place promiscuously, that is to say the individuals copulate at random with members of the opposite sex. Here, therefore, promiscuity is the general rule. In exceptional cases, however, among certain species of insects and spiders (see below) mateships may also be formed.

It is easy to show that promiscuity exists in the case of *Alytes obstetricans*. At each breeding season the female produces her eggs in three or four separate layings. These, as they emerge from the body of the mother, are fertilized by the male, and the latter immediately winds the whole laying, stringlike, round his hind legs. Thus it often happens that a male carries about, at one and the same time, strings of eggs belonging to several different females. In the case of the fish *Callionimus lyra*, which lives rather in associations than in societies, the male and the female deliver eggs and

sperm while, with their abdomens pressed together, they rise to the surface of the water. Near the surface the fish, which appear to delight in copulation, separate, but after a short time go through the act again, sometimes with a different partner. Promiscuity also obtains among many reptiles.

True promiscuity occurs in the case of the cuckoo, which leads a solitary life throughout the year. In this species there are two males to every female. Each male remains in its own sharply circumscribed domain, and the females roam from one male to another, often pairing with six different males. It is altogether wrong to call this polyandry, for all the criteria of promiscuity are present.

IV SOCIAL INSTINCTS IN SOLITARY ANIMALS

Even among solitary animals phenomena of an undeniably social nature sometimes occur. On such occasions a social instinct awakens in them which does not manifest itself at other times. Thus groups of solitary animals are constituted for breeding, hibernating, migrating, and sleeping.

The swarms of dancing males formed by certain solitary insects, e.g. midges, flies, *Neuroptera*, day-flies, and *Perlidae*, are breeding societies. The females probably seek out these swarms, and as soon as a female approaches one of them, several males throw themselves upon her; copulation ensues, however, with only one of the males. Among certain solitary insects, namely horseflies and some butterflies, the males and females collect in high-lying conspicuous places. Breeding societies are also found among certain species of snakes; twenty or thirty individuals roll themselves into a kind of ball and remain thus for hours, performing, meanwhile, the sexual act, pair by pair.

Migrating troops are often formed by certain insects which normally live in solitude: by caterpillars, for instance, and the larvæ of other genera, by butterflies, dragon-flies, and locusts. Different species belonging to the same genus may combine to form a single migrating troop. Within these companies the striving of the animals concerned to hold together is unmistakable; in consequence they travel over the ground or through the air in sharply defined masses.

The reason why these migrations take place is still unexplained ; they are not the result of a lack of food, or, at least, not always. Whenever, in hot weather, a number of locusts sit together in a compact group they become more and more excited until suddenly they take flight in a body. In their course they attract to themselves every member of their own species, so that the swarm increases like an avalanche (Brehm, vol. ii, p. 6). Thus what was originally an association becomes a society. In addition to these flying swarms of full-grown individuals, migrating swarms of locust larvæ occur. With dragon-flies the migrating host increases in the same way as with locusts, since every dragon-fly in the district traversed joins the throng.

The larvæ of *Sciara militaris*, a species of midge, lead, as a rule, a solitary life hidden in the ground ; at times, however, they come to the surface, collect in large swarms, and set out on migrations (hence the name army-worm). If one scatters the migrating insects they gather together again. In contrast to the animals that I have named, lemmings migrate as solitary animals, in the manner described above, even when they appear in large numbers.

Sleep societies occur among certain species of bees and wasps, as well as among butterflies (von Frisch, 1918, Schrottky). During the day the insects live apart, but in the evening the group in question always seeks out the same place ; the number of individuals present varies a little from day to day ; it may therefore be assumed that a few, at least, sometimes spend the night in one place and sometimes in another. Only males and unfertilized females are members of such sleep societies ; the fertilized females live

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in strict solitude, and devote themselves to the care of their young.

On certain occasions social tendencies generally manifest themselves among the males of some kinds of butterflies. Thus it is known that butterfly collectors can procure many males of these species by exposing here and there one or two males killed for the purpose. Other males then arrive and settle near them. But the assembled butterflies do not appear to enter into any discernible relation with one another.

Hibernating societies are found among various amphibians and reptiles ; thus in the autumn salamanders, slow worms, lizards, and snakes of the same species seek out common hiding places. But whether they are guided by a social instinct is as yet uncertain ; sometimes there can be no question of anything more than an association, since suitable hiding places are not very easily found. Hibernating societies also occur among certain solitary insects ; fleas, for instance, cluster together in buildings which are uninhabited during the winter.

In the case of amphibians it is impossible, according to Brehm (vol. iv, p. 26), to talk of a common social life ; the fact that they inhabit the same locality is the only bond between them. And yet frogs, for instance, are adapted for living in associations, and those companies of them which animate lakes and ponds, pools and rivers, during the warm months of the year may perhaps with some justification be regarded as intermediate between associations and societies. Frogs often begin and end their croaking all together, as anyone may hear for himself. The noise made by a frog

in jumping into the water (the splash sound, Yerkes, 1903), the croaking, and the cry of a frog in pain acts as a warning to other frogs ; but no frog takes to flight before it has itself seen the enemy. It is impossible to approach a frog in its native haunts if another nearby has already leapt into the water in flight. Noises other than those mentioned have no sensitizing effect on a frog, though it may well have heard them.

V SPECIAL ANIMAL SOCIOLOGY : SOCIETIES

In this section we must discuss the sociological behaviour of those animals which, either temporarily or permanently, live a social life. I will endeavour in what follows to proceed with as little high-handedness as possible in dividing up my subject matter, making divisions only as they become necessary ; but since nature knows no scheme or system, a certain arbitrariness could not be avoided. It is not easy to delimit the concept of " temporarily social " animals from that of solitary animals displaying on occasion a social instinct. The last mentioned cases have already been discussed above. Among temporarily social species we will include those whose members consort with the opposite sex at least during a protracted breeding period, or which on other occasions as well seek members of their own or other species. The concept " protracted " is naturally a highly relative one ; how I understand it will appear in the course of my exposition. The term " permanently social animals " explains itself ; temporarily and permanently social species cannot be sharply divided from one another ; transitions of every kind occur. In order to divide the " states " of bees, ants, termites, etc., suitably from all other animal societies (for on account of the morphological and psychological differentiation of their " castes " these " states " are formations of an altogether special kind), I shall in the first instance discriminate between (A) species in which every

individual normally attains full sexual development, and (B) species in which the greater number, or the vast majority, of individuals are asexual, i.e. the "state" forming insects.

A SPECIES IN WHICH EVERY NORMAL INDIVIDUAL BECOMES CAPABLE OF REPRODUCTION

Among the species all of whose members, apart from abnormalities, are capable of reproduction, we may divide those in which reproduction takes place at fixed seasons from those which breed practically without interruption. The majority of social species are included in the first category ; among them rutting periods alternate, in regular yearly rotation, with periods of sexual inactivity. The second category possesses a peculiar interest in that it includes human beings.

For members of the seasonal species breeding time brings with it a more or less radical change in all their habits. Individuals which, until that time have led a solitary life, then attach themselves to partners of their own race ; or, again, companies of animals which have been living peacefully together break up into separate couples and families ; at the very least a radical reorganization of the herd occurs. In what follows, therefore, we shall have to consider (1) the behaviour of both temporarily and permanently social animals during breeding time separately from (2) their behaviour at other periods. Those species whose members live permanently mated are relatively least affected by the seasonal rutting period ; yet even in their case this period brings with it manifold changes in the daily conduct of their lives.

1 Reproduction

In considering behaviour during reproduction we must distinguish between (a1) relations to the other sex, and (a2) relations to offspring. The case (a3) of those excluded from reproduction deserves separate attention.

a1 Relations to the Other Sex

Sexual intercourse among social animals with seasonal rutting periods may take place either (b1) by the members gathering together and emitting their sex substances into the water, as we have already seen to be the habit of some solitary animals living in associations ; in this case there is no mateship and no formation of a family. Or (b2) by each animal entering into separate sexual relations with another.

b1 The Emission, in common, of the Sex Substances by the Collected Individuals

The majority of fishes, especially the salt-water species, emit eggs and sperm loose into the water ; fertilization is then left to chance. In this connexion the species which most interest us are those which live in swarms ; among them it is common for the females to swim above the males during spawning so that the eggs as they sink must pass through water saturated with semen (Brehm).

b2 Individual Sexual Relations

Sexual intercourse between one individual and another may either take place (c1) promiscuously, or (c2) a mateship may be formed between two members of opposite sexes. Either such mateships are strictly adhered to by both mates,

or again both may adopt promiscuity. In that case promiscuity as an accessory phenomenon stands side by side with permanent mateships as the rule. If one or both of the parents remain for a time with the offspring then the mateship gives rise to the family ; but many parents forsake the eggs before the young emerge.

c1 Promiscuity as the General Rule

We met with promiscuity as the normal form of sexual intercourse among solitary animals, insects in particular ; further among fishes, amphibians and reptiles, and in the case of the cuckoo. Promiscuity among gregarious animals is extremely rare. Formerly people were inclined to take it for granted that within a herd the sexual act is performed indiscriminately between the individual members (for a time this was quite wrongly supposed to be the custom among primitive races). It was imagined that if at breeding time any male came together with any female within the herd copulation at once ensued.

Some species of lizards living gregariously adopt promiscuity. True promiscuity appears to exist among bats which live gregariously ; in any case several males have been observed to pair, one after another, with the same female ; other males which happened to be present at the same time exhibited complete indifference. Promiscuity is said to have ruled among North American bisons ; but this assertion must remain a matter of controversy. The North American cow-bird (*Molothrus ater*), which lives gregariously throughout the year, is promiscuous in its habits ; it is interesting that this bird, like our cuckoo, is a parasite so

far as hatching out the eggs is concerned. Promiscuity very probably exists among black game and capercaillies. While the domestic cock, as is well known, keeps his hens together throughout the year, among the two last mentioned species, during pairing time the male forsakes immediately after each copulation the females which had collected at the pairing ground. Capercaillies have, on an average, four, and black cock eight hens. Apart from the short periods during which they meet every day at the pairing ground, the sexes, in this case, lead a perfectly separate life (Doflein, p. 473). A polygynous mateship is not formed, as it is among certain other gallinaceous birds; and it is quite possible that individual hens seek out the pairing ground now of one male and now of another. Over and above this there are black cock that fly from pairing ground to pairing ground, fighting there with other males for the favour of the female. According to Naumann (vol. viii, p. 264) pairing takes place promiscuously among ruffs (*Machetes pugnax*), which live in societies.

Promiscuity is asserted to exist among argus-eyed pheasants, quails, and also among hares. But perhaps permanent partnerships are the rule here too, and their existence is overlooked by observers only because the partners do not abide by them over-strictly. Promiscuous habits were long ascribed to foxes, but it has now been established that they live monogamously (Brehm). The fact that house dogs pair promiscuously is a consequence of their domestication, seeing that the special conditions of their association with men prevent any permanent mateship.

It has never been ascertained whether polygynous mating

takes place among wild pigs in the breeding season or whether promiscuity is the rule. The latter is frequently asserted. At breeding time the males, which otherwise keep to themselves either alone or in separate herds, unite with the herds of the females, these latter being accompanied by the sexually undeveloped young. Long-drawn-out battles then take place among the males, which result either in the removal of a rival by one of the males, or the mutual toleration by two equally strong males of one another's presence within the same herd. In this last instance it is conceivable that promiscuous pairing ensues (it might be permissible to speak of some kind of "group mating" here), or, again, the right of possession over the different females may have been strictly delimited as between the rivals.

The greater number of fishes emit eggs and sperm into the water without the male and female thereby entering into any individual relations with one another. This, however, is not always the case; among perch and other species, the female lays its eggs and several males then discharge their sperm over them. If the females lay eggs more than once during one and the same period of sexual activity, then promiscuity and not polyandry exists.

Sticklebacks and *Gobius* belong to the fishes which live in swarms, males and females together, except during the pairing season. At the beginning of the breeding period the males isolate themselves, and each one then builds a nest within a circumscribed area which is thenceforth stoutly defended against every intruder. When the nest is finished the male fetches some female, which thereupon lays a few eggs in it. The male then fertilizes the eggs. On the next and

following days the male again regularly fetches another female, until a considerable number of eggs has been deposited. The females in this way lay their eggs in the nests of different males.

c2 Mateships

As against promiscuity we may contrast mateships. These may be monogamous, polygynous, or polyandrous; the last is rare. Mateships are either (*d1*) seasonal, that is to say the partnership is dissolved at the end of the rutting season, or they are (*d1*) permanent or enduring mateships, when they outlast the periods of sexual inactivity which recur each year; among many birds of which seasonal reproduction is characteristic, the monogamous mateship, once concluded, lasts throughout life until death separates the mates. Mateships are either solitary, in which case the male separates himself and his mate, or his harem, from others of his own kind, or several mateships (whether monogamous or polygamous) join together to form a community. Permutations and combinations of these different possibilities yield several categories. Unfortunately our knowledge is still very imperfect; thus in respect of certain species we do not know whether they live in seasonal or in permanent mateships. Such doubtful cases will be mentioned later in their appropriate connexions.

d1 Seasonal Mateships

Seasonal mateships do not outlast the breeding period, this owing to the fact that members of the species concerned live a year at most, or that, in the case of animals

living longer than a year, a new partner is chosen at the beginning of each breeding period. Seasonal mateships may be either (*e1*) solitary, or (*e2*) within the herd.

e1 Solitary Seasonal Mateships

In solitary seasonal mateships the partners, linked together in (*f1*), monogamy, (*f2*) polygyny, or (*f3*) polyandry, live for the time a solitary existence, and do not enter into relations with others of their own kind.

f1 Monogamy

Monogamous solitary seasonal mating is found among a number of beetles. In these species male and female remain together throughout a summer, copulation taking place several times; the couples live, at most, in associations, not in societies. Only in the case of a very few insects does the life of the individual, after it is full grown, last more than a year (Korschelt); it is, therefore, perfectly justifiable, wherever mateships are formed, to speak of seasonal mating. In the case of the dung beetle (*Minotaurus typhoeus*) the method of forming a mateship is for the female to choose one out of a number of males; she always knows him again, and keeps by his side (Doflein). The lamellicron beetle (*Ateuchus sacer*) lives paired with a mate within an association formed near a favourable feeding ground. Male and female co-operate in making their pills of dung, and these they defend against other members of their own species, later using the pills as food for themselves or their offspring. Among wood-boring *Passalidæ* and other beetles, the monogamous parents feed the larvæ and guard the chrysalides.

The male and female of water spiders (*Argyroneta*) remain together throughout the year ; also certain species of crabs live together in pairs (Doflein, p. 467). Whether among water spiders and the crab species in question the case is one of seasonal or permanent mateships has not yet been determined.

Seasonal mating occurs among certain fish species. Thus the female salmon lays its eggs and they are then fertilized at intervals by the male which remains present whilst they are being laid (Brehm). Rivals are driven off by the male. During the fights which occasionally arise it sometimes happens that young males arrive and fertilize the eggs ; these play the part of *tertii gaudentes*, as young deer do in similar circumstances (accessory promiscuity). If the full-grown male meets his death, the female fetches another to the spawning ground (second mateship). It is inadmissible to regard this as polyandry. Societies formed by shoals of small carp (*Rhodeus amarus*) break up at pairing time into monogamous partnerships, only to collect together again after the time is over. Graylings (*Thymallus*) consort together in pairs during the breeding season. Among *Labrus* and some *Cichlidæ* both parents protect the eggs and supply the young with food.

In many amphibious species the couples seem to cling to one another at pairing time with great affection ; however, they separate at the close of the breeding period (Brehm).

Rhinoderma, for instance, live monogamously. The female lays eggs repeatedly, one or two at a time, at intervals which may extend to several days, and after their fertilization by the male collects them into a gular sac,

Some reptiles live in pairs during the breeding season ; cobras, *Cyclura*, wall lizards (Doflein, p. 468), also emerald lizards and pearl lizards usually live together in pairs throughout the breeding season (permanent mateship ?).

With some birds the mateships do not outlast the breeding season ; so that a fresh mateship is entered into with a different individual at the beginning of each such period. Some mammalian beasts of prey live monogamously but none throughout life. In certain cat and marten species the two sexes consort with one another both during and after the breeding period in order to protect and nourish the young. In the case of lions a fresh mate is chosen at every rutting time ; during pairing time monogamy is the rule. Male and female jaguars live together monogamously for four or five weeks ; during the rest of the year they lead a solitary life. Foxes live monogamously ; the female accepts only one suitor and the father (contrary to earlier belief) defends the young and brings them food. Wolves live in couples during the spring and in packs during the winter. Wolves, foxes, and bears live mated for a certain period even after the actual rutting time is over (Doflein, p. 479).

It is uncertain whether seasonal or permanent mating is the rule among certain other mammals. These appear in couples throughout the year, and are accompanied for a time by their young. The species concerned include certain kinds of dolphins, *Sirenoidei*, pigs, deer, and antelope, also apparently the blue whale. It seems very likely that for some of these species, especially the small antelope, permanent mateship is the rule.

Our ignorance about the duration of some animal mate-

ships is in part due to the fact that we have not yet any exact information about the rutting times and laying periods of many kinds of tropical wild animals. The reason for this is that the majority of hunters sally forth with a purely sporting interest, i.e. they aim at the destruction of a large amount of game in the shortest possible time. Unfortunately the only method known to the majority of men of dealing with the animal creation, in so far as it is not a question of purely domestic animals, is that of shooting them down or in other ways doing them to death. According to Berger, the assumption that African wild beasts breed throughout the year is false ; on the contrary, breeding time falls, generally speaking, in the dry season ; but this differs in different regions. The length of the period of gestation varies with the species ; and, correspondingly, the rutting time varies from species to species. Animals kept in confinement naturally do not afford a reliable source of information in consequence of their completely altered external conditions. In opposition to Berger, Schuster believes, amongst other things, that at least in the case of certain antelope species, no periodic heat occurs, and that consequently the breeding period extends over the whole year. (With regard to zebras and rhinoceros see below.)

f2 Polygyny

Seasonal solitary polygynous mateships exist among some bark beetles. The male establishes a sort of nuptial chamber under the bark, one after another a number of females enter it, and each after the resulting fecundation gnaws out a hatching place in which she lays her eggs.

Many mammals, too, live in such mateships. The following behaviour is typical of many species : outside pairing time the males do not concern themselves with the females, but live an independent life, either singly or in troops. When mating time arrives they seek out the females and either attach themselves to the troops of the latter or collect together the largest number of females they can, and fight every rival. Only young males incapable as yet of reproduction are tolerated. Among Indian buffalo the herds break up at the commencement of pairing time into small bands, each gathered round one steer. In the following remarks bands of females, guarded by a single male, and sometimes accompanied by other immature young males, will be described, for the sake of shortness, as "harems". It is characteristic of the seasonal harem that it is abandoned by its overlord every year at the end of the breeding period. The harem either scatters to the winds (e.g. among elks) or remains together as a "herd of mothers". It should be stated in regard to the organization of a seasonal solitary harem, that in certain cases the leadership of the herd is taken over by the male overlord ; on the other hand this business is often left to an old and experienced female who also presides over it during the period of sexual inactivity, when the male has long since taken himself off.

Among stags at rutting time the strongest male drives off all younger males and rivals from the herd of females, comprising from six to twelve animals, which he has selected. The herd is invariably led by a female, and all the other females follow her guidance. This leadership obtains even during rutting time. During the vigorous battles between

the principal stags, the younger males sometimes stealthily enter the herd and cover its female members ; they likewise appear when the old males have become impotent, and then themselves cover the females (the two last-mentioned instances should be rated as accessory promiscuity). Sexual activity takes a similar course among other deer, among many antelopes, among wild sheep and wild goats.

Among Indian elephants, moufflon and waterbuck the harem also possesses a female leader. The function of the accompanying male is then merely to possess the females. In earlier times such a harem of elephants consisted of thirty or forty full-grown females ; that to-day much smaller harems are encountered is due to the severe persecution which elephants have suffered during the last few decades. We find solitary harems among most deer, among many antelopes, among wild goats and wild sheep, without it being possible, up to now, to establish with certainty whether in every case the male or the female takes the lead. The information we at present possess is to some extent self-contradictory. Among gaur, a species of Indian wild buffalo, every herd of from eight to ten head contains, outside rutting time, two herd bulls. At pairing time an otherwise solitary bull joins the herd, who proves himself more than a match for the herd bulls and rules unrestrained as long as the rut lasts. In spite of his presence, the herd bulls usually remain with the herd.

Wild cock pheasants seem to live monogamously and the male takes a share in the rearing of the young ; on the other hand, half-domesticated pheasants are polygynous, and the male, in this instance, does not concern himself with his

offspring ; when his sexual instincts are satisfied he thus forsakes the harem which he has gathered ; the females scatter and devote themselves, each independently of the others, to the care of their young. The behaviour of black game and capercaillies at dancing time apparently lies on the borderline between polygyny and promiscuity, as we saw above.

f3 Polyandry

Polyandry is rare (Deegener, p. 258) ; it occurs, so far as I was able to see, only as a form of solitary seasonal mateship, and so should be treated in this context. It is invariably connected with the fact that in the species concerned the males are considerably smaller than the females. Among *Alcippe*, a cirripod belonging to the race of crabs, the females live as a rule in associations ; from three to twelve dwarfish males join a female and remain with her through life. In the case of the worm *Bonellia* up to eighteen males attach themselves to every female ; here, likewise, the males are disproportionately small compared with the females. Polyandry also exists among certain spiders, where two males attach themselves to each female and copulate repeatedly.

e2 Seasonal Mateships within the Herd

The different types of seasonal solitary mateships have been discussed in the previous section ; such mateships occur when a monogamous couple, which have united for one breeding period only, or when the polygynium or the polyandrium remains solitary. There are, however, cases in which the individuals united in a seasonal mateship

remain members of a larger herd unit. In these instances the herd of sexually inactive animals undergoes a reorganization at the beginning of the sexual period; it does not, however, disperse into separate partnerships, on the contrary these continue to keep together. Those seasonal mateships united into a larger unit are either (*f1*) monogamous, or (*f2*) polygynous; no case of polyandry has ever been known.

f1 Monogamy

From the nature of the case it is frequently very difficult to decide whether the mateships of gregarious animals are seasonal or permanent, when the animals in question are monogamous and yet do not abandon their communal life during the breeding period. To get unimpeachable results one would have to mark paired animals in some way which leaves them unharmed and then watch them carefully from year to year.

Many rodents which construct their burrows colony-fashion, and which obviously have dealings with one another inside these stationary societies, have been found at breeding time in their burrowing places in pairs, e.g. marmots, rabbits, prairie dogs, chinchillas, beavers, and rats. Since rabbits are now said to live in mateships that last several years, it may be conjectured that this also occurs in the case of one or other of the above-named rodents. The oryx antelope (Doflein) and many whales live monogamously within wandering herd groups. The Beluga whales live in this way in schools within which the animals live in pairs, accompanied sometimes by a young one. Steller's sea-cows (*Rhytina stelleri*), which in their time inhabited the Behring

Sea, and are now extinct, lived monogamously within the herd unit. Their discoverer, Steller, reports that a male came two days in succession to the beach where the female, which had been killed, was lying (Brehm). Further, the sea-otter (*Latax*) lives monogamously in a herd unit ; male, female, and the young which belong to them keep together within the group. In all these cases, as I have already remarked, it is not certain whether we should speak of seasonal or permanent mateship ; were the latter proved true in one or other case, then the species concerned would have to be classified not here, but under a heading to be discussed later.

Many birds, as is well known, nest in colonies. Thus they do not abandon their gregarious mode of life even during the time of incubation ; it is above all a social instinct, not the specially favourable nature of the environment, that forces them together. It is often doubtful whether we have here a case of seasonal or permanent mateship. But since the majority of birds live in mateships we will leave all bird colonies to be considered together in their appropriate place ; let it suffice, at this point, to hint that perhaps one day the existence of seasonal mateships among one or other of the bird species which hatch in colonies, will be established beyond doubt. Among Central European swallows, which nest in colonies, the couple remain together often during one incubation only, pairing afresh for the next.

f2 Polygyny

The cases in which seasonal polygyny occurs together with the continued existence of the herd as a unit are easier

to establish. The structure of a herd of sexually active animals differs considerably from that of a herd during the asexual period. At the period of sexual inactivity the sexes not infrequently divide into separate groups, or at least hold together in two distinct bodies within the herd. The awakening of the sexual impulse brings about a complete alteration in so far as the herd now consists entirely of harems. Let us take seals as an example. In the species *Callorhinus*, the fur-yielding seal, the bulls live separately in herds in the open sea, and so, to a certain extent, do the bachelors, i.e. the males which have not reached pairing age; these bachelors also appear sometimes to attach themselves to the herds of females with their young. At the beginning of the breeding season the old bulls are the first to come to land, where they occupy their accustomed rocks; later the troops of females appear, and immediately the males begin to collect together harems, numbering usually from fifteen to twenty-five, and at the most forty, females (Doflein, see illustration, pp. 475-8). The females may be either about to be delivered, or if one year old only, still virgin. Furious fights then take place between the males until gradually a balance of power is established and the rights of each animal are defined and recognized. The old bulls, defeated in combat and driven off, and the bachelors prevented from pairing by the lords of the harems, hold themselves in two separate groups. When all the cows have been covered the harems are dissolved and all the animals betake themselves again to the open sea. Reproduction follows precisely the same course among other species of

d2 *Permanent Mateships*

What serves to characterize a permanent mateship is the fact that the partners hold together either through several breeding periods or for the whole of their lives. Permanent mateships may be either monogamous or polygynous. Polyandrous partnerships, which could be described as forms of permanent mateship, are so far unknown. Both monogamous and polygynous mateships may be either (e1) solitary or (e2) comprised within more or less extensive herd communities. Permanent monogamous mateships occur both among species with uninterrupted, as well as among those with periodic reproductive activity. The latter case is especially noteworthy because among species with regularly interrupted sexual activity it cannot be the sexual impulse alone which holds the monogamous couples together throughout the year ; as I have already said in the introduction, a second instinct is necessary before a true mateship can be formed.

e1 *Solitary Permanent Mateships*f1 *Monogamy*

Monogamous solitary permanent mateships are characteristic of many bird species. The common raven and numberless birds of prey live in solitary couples throughout the year, and do not migrate to more temperate zones during the winter. Other birds of prey and also partridges do not migrate, and while being strictly monogamous (mating in some cases, like the partridge, for life) gather together into flocks during the winter. On the other hand grebes live permanently in solitary couples which migrate together to

the south, and together come back again. Other birds, on the contrary, travel in flocks to warmer regions, although the couples not uncommonly remain united within the flock.

Among chaffinches returning from their winter quarters, males and females fly in separate flocks, the males about a fortnight ahead of the females ; the divided couples usually meet one another again at the old hatching ground, each bird there rediscovering its old mate. In some parts the males remain behind throughout the year while the females only migrate, so that in such cases the monogamous mateship outlasts even a winterlong separation of the mates. In many species the couples, on their return, seek out the same spots, if not the same nests.

Permanent mateship, among some species, does not last a lifetime ; among others, on the contrary, it is terminated only by the death of one of the mates. In many bird species lively battles are fought between the males for possession of the females ; and in the case of species which commonly pair for life it may happen that an unfavourable issue costs the defeated bird his mate (*Haliaeetus*). In some species the female vigorously supports her mate in battle with a rival. Sometimes the mates are greatly attached to one another ; thus, if old nightingales, which have paired beforehand, are imprisoned, they regularly die ; whereas younger birds, which have not paired, can endure captivity (Brehm). Widowed birds pair again, both in a wild state and in captivity if suitable mates are available. Among storks, and some birds of prey, if one partner perishes the survivor is said to seek out a new mate so that with the help of the latter it may complete the rearing of the young (Doflein).

Among other species of birds, on the contrary, one parent alone brings up its offspring ; whilst in yet other species the father, at least, cannot do this unaided.

Monogamy is either strictly observed (cranes, geese, and swans), or one of the two mates permits himself an occasional infidelity (accessory promiscuity). Cases have been known in which a female stork, already paired, has allowed itself to be trodden by a strange male. Coots live monogamously, and the couples hold together apart from other birds during the period of incubation, though an unmated hen may lead the male into a passing infidelity. Contrary to what used to be asserted, and in contrast to related species found in South America, the African ostrich is monogamous (Brehm). The male arranges the nest, and male and female relieve one another during incubation. As there are more females than males, the surplus hens wander about and allow themselves to be mounted by males which have already paired ; these females, since they do not arrange a nest for themselves, lay their eggs in any nest they come across ; thereupon, a battle with the rightful owner may take place over the nest, in the course of which all the eggs may possibly be destroyed. Outside pairing time ostriches live gregariously ; how long the mateships last has not yet been ascertained.

There are many mammals of which we cannot yet say whether their solitary monogamous mateships are seasonal or permanent. Solitary permanent mateships seem, at least, to occur among the various species of rhinoceros ; the same applies to some apes, and their hybrids. According to Volz, the orang-utan lives in solitary permanent mateship.

The permanent mateships of the rhinoceros are possibly

connected with the fact that, according to Schuster, these animals breed uninterruptedly throughout the year. Deeg., it is true, asserts that in this case, too, breeding is periodic. In the same way permanent mateships among apes are rendered more probable by the fact that, for some species at least, it is firmly established that the males never lose their reproductive powers, and that the females menstruate at monthly intervals throughout the year. But even in these cases the impulse, already alluded to, prompting the formation of a real mateship should not be altogether lost sight of.

f2 Polygyny

The domestic fowl provides a typical instance of solitary and permanent polygynous mateship, since the cock keeps his hens together throughout the year. In the case of the Nandu, the South American ostrich, the cock bird lives during breeding time with a flock of hens, numbering from five to seven, inside an area which he holds throughout the period against every other member of his own species. The hens lay all their eggs together in one nest, but incubation is done by the male alone. During the time of incubation the hens remain together within the area held by the cock bird. First of all the chicks alone follow the father, and the hens join them later on. When hatching time is past several polygynous families, with the chicks belonging to them, collect together in larger groups; nevertheless whereas the family tie holds fast beyond the breeding period, the tie which holds the larger union together is looser, for the separate families attach themselves now to one and now to another flock. During breeding time then, the Nandu lives

in solitary polygynous mateships, and these mateships are permanent because they continue in existence during the period of sexual inactivity when the birds congregate together with the members of other family units.

Among mammals each herd of guanacos and vicunas consists, both during and after breeding time, of a number of females and one male ; only young males as yet sexually undeveloped are tolerated by the old male. The latter leads the harem, looks after its safety, and covers its retreat. If the male is killed, the females, left leaderless, wander about aimlessly.

Among primitive Asiatic wild horses each herd consists of a stallion and his harem, which contains from five to fifteen mares. Herds of zebras are organized in the same way ; if the stallion perishes the mares are received into another harem (Schillings). Several herds of zebras, each made up of a stallion and his harem, may temporarily unite into larger herds (see below) ; such groups are, nevertheless, but loosely connected, and break up easily into their component parts, the separate polygynous mateships. During these temporary alliances each stallion watches jealously over his harem. Among zebras there is no settled time for parturition ; Deeg. has observed coverings to take place and foals to be born at all times of the year.

Where, as in South America, the domesticated horse lives in a semi-wild state, every stallion is given from twelve to eighteen mares which he holds together. Each group lives apart, and keeps to itself, and should the groups, by any chance, merge with one another, e.g. as the result of a large number of horses being driven together, the various troops

immediately separate out again. The surplus stallions are gelded, and these geldings keep apart in herds of their own. All stallions, even those which hitherto have passed their lives in a stable, show the instinct to collect together a number of mares and possess them (Brehm, vol. 12, p. 699), and the latter offer no resistance ; clearly then both mares and stallions possess an instinct for such polygynous mateships.

Among one of the Asiatic species of wild asses, the herd leader is likewise a male ; and the older he becomes the more mares he gathers about him, the number varying from three to fifty. If the male is killed, the herd breaks up. With the Nubian wild ass, on the contrary, it is said that the herd, which contains from ten to fifteen mares, is led by an old mare (Brehm) ; such a harem, however, is always the property of a single male, who obstinately defends his rights.

Every herd of kangaroos frequents a special grazing place, and sometimes more than one, these being linked by well trodden pathways. One and the same herd remains a constant unit and does not mingle with others. Each is led by an old male which it follows blindly, either when grazing or when in flight. When pairing time begins, the leader claims the females belonging to his herd as his own property, but the claim is not allowed without fierce battles with other males who have come to maturity since the previous breeding period. These battles may result in the breaking up of one herd into several, which thereafter exist as separate units, each led by a male.

Solitary and permanent polygynous mateships also occur

among some apes, e.g. among macaques ; the horde forming the harem is always led by a male, and contains from ten to fifty animals. Some writers have called this leader " the pacha ". He suffers no other male near him, and any rebellious animal is disciplined with kicks and cuffs. In climbing, the members of the horde are careful to keep to the route taken by the leader, and the whole procession then goes through identical movements at any given place. If the leader is killed the herd becomes completely helpless. According to the authorities on this subject, each such herd is believed to consist of the ramifications of a single family ; and the leader is claimed as its founder ; this, of course, is merely an hypothesis. During the search for food, the leader keeps guard, and in case of need warns the herd, which thereupon takes to flight. During the retreat the leader, from time to time, looks back at the pursuer. Each horde usually clings to a special area, which it never abandons. If two hordes encounter one another the leaders sometimes fight a duel, and if one is mortally wounded his harem may well join in the fray. Brehm reports that occasionally one horde will attack another and drive it from its dwelling place (which, in India, is sometimes an ancient temple).

e2 Permanent Mateships within a Herd

Permanent mateships within a larger unit are of special interest since human marriages must be classified under this heading. Among animals such mateships may be either (*f1*) monogamous or (*f2*) polygynous, and the same is true of men.

f1 Monogamy

I shall discuss the subject of permanent monogamous mateships within a herd in special detail because sociologists insist that such mateships are unknown in the animal kingdom, and "therefore" conclude that, as found among men, they are purely arbitrary institutions having no "natural" foundation. This is one of the numerous cases where zoology is called in, quite wrongly, to corroborate some purely fictitious assertion.

According to the interesting facts ascertained by Reichenow, the gorilla comes under this heading. The West African gorilla lives in bands numbering from ten to twenty, the East African in bands numbering from twenty to thirty animals. During the day the herd scatters over a fairly wide tract of country, but reassembles in the evening. Each gorilla builds a nest for the night, those of the full grown animals measuring from two to three metres across. From the arrangement of the nests relatively to one another, Reichenow was able to arrive at important conclusions about the family life of gorillas. In the virgin forests of Northern Africa the nests are built on the ground; only females with very young offspring build their nests about one and a half metres above the ground. In the south, on the contrary, the females and the younger animals alone build nests, and these are placed from five to six metres up in the trees; the males spend the night on the ground without a nest at all. Apes belonging to the central region seem to occupy a middle position, since in their case some members of a herd will build a nest near the ground, and others one from three to five metres above it. A shelter against rain

is never provided. The nest is used always for one night only, and in the morning, on departure, is not infrequently befouled with excrement. According to Reichenow, nest-building probably depends entirely upon tradition, and not upon a sharply defined and specialized instinct (as among birds), for only gorillas captured after a certain age show, in captivity, any inclination towards arranging a bed, a thing never found when the animals are taken very young from their mothers. Perhaps, then, a difference in tradition is responsible for the fact that gorillas build differently in the north and in the south. Köhler, however, in the course of his investigations with chimpanzees, came to the conclusion that nest building among this species is purely instinctive (see below).

According to Reichenow (p. 16), the gorilla lives not polygynously, but monogamously within its hordes (this contradicts Zenker's assertions) ; the sexes do not associate merely during each breeding period, but remain together during many years. The half-grown apes evidently stay for a long time with their parents, perhaps even until they found a family of their own. The horde therefore consists of a number of monogamous couples and their offspring. It is not known in what family relationship the members of a horde stand to one another. Reichenow observed that a horde is never composed of more than five families. This division into families is expressed even in the daily arrangement of the nests. Reichenow found that in the northern region the nests of a horde were arranged not irregularly, side by side, but in ordered groups, which were divided by spaces from eight to fifteen metres wide. Each group

contained two large nests, those namely of the two parent apes, and from one to two smaller nests belonging to their half-grown offspring, who from the age of about three or four years onward occupy sleeping places of their own. As long as the young are still quite small they spend the night with the mother, who builds a specially soft nest placed specially high.

Von Kappenfels (quoted by Brehm) describes the father as forcing his mate and his offspring to pluck and fetch fruit for him, dealing out boxes on the ears when this is not done quickly and lavishly enough ; Zenker relates the same thing.

Very old male gorillas, and these alone, live without a mate. According to Reichenow, they are always animals which have ceased to have any desire for the female, and which have lost touch with their companions in consequence of the break up of their families ; whether an old male is expelled by one or more of the younger males is not known. Such occurrences—still hypothetical as far as apes are concerned—play a part, as is known, in discussions of the " Oedipus complex ". We have likewise no information as to the fate of old females living independently of a mate within the herd ; they are not met with living apart from other animals of their own kind.

The chimpanzee, like the gorilla, lives in bands, and the former avoids the latter ; Reichenow believes that interbreeding between the two species is therefore very improbable, for every female is protected by her own horde. It is unanimously denied by travellers that old gorillas carry off women. Reichenow is of the opinion that these

tales of woman-stealing gorillas originated in the notion that sorcerers could assume the forms of gorillas, leopards, or elephants, and in this guise were able to play all sorts of tricks upon their fellow creatures. Like the gorilla the chimpanzee builds itself a sleeping nest every night, which it uses only once ; this is built in the trees, twenty to thirty feet above ground. What has been said of the nest-building impulse of gorillas is true also of chimpanzees ; according to Reichenow this depends upon tradition, according to Köhler it is purely instinctive. The chimpanzee knows how to protect itself against rain with branches, which it lays over its back. Much less is known about the family life of the chimpanzee than about that of the gorilla. The former are encountered in hordes of twenty to thirty head. According to Reichenow, since material suitable for observation is entirely lacking, assertions about polygyny among chimpanzees are purely imaginary. Very old chimpanzees live quite alone without a mate.

Every horde of gorillas or of chimpanzees inhabits a perfectly well-defined and limited area, whose size is regulated according to the number of animals in the horde ; for a horde of average size its diameter, according to Reichenow, measures about fifteen kilometres ; the domain of an old male, living alone, is correspondingly smaller. These in particular defend their area obstinately against every intruder. The hordes wander through the whole domain in every direction, and in so doing the animals contrive never to spend two successive nights in the same place, although at the end of several weeks they ever and again return to the neighbourhood of a former sleeping

place. This wandering life is conditioned by the vegetarian habits of gorillas and chimpanzees, who, in their wild state, feed exclusively upon fresh shoots. Unlike gorillas, a horde of chimpanzees seems always to travel in unbroken file, one member following close on another. These circumstances produce a constant coming and going in any region where chimpanzees abound.

Other species of apes also live monogamously within a horde; this seems to apply, for instance, to the members of the *Callithrix* family, which inhabit South America. In this instance, the female bears from one to three young at a birth, and carries them about with her; from time to time she induces the male to carry the children, which he does without hesitation. Tame guinea pigs live monogamously within their herds. Their breeding period lasts throughout the whole year; at the beginning two unmated males may fight for an unmated female; one of them pairs with the female, and from then on this ownership remains undisturbed. Among Patagonian cavy (*Dolichotis*), a species allied to the guinea pig, which lives in herds, the mates are so closely attached to one another that they come together again even if they are separated for months and the female is shut up with another male (Brehm). Wild rabbits construct their burrows in the form of colonies where the different passages in which they live communicate with one another. They have been said to form monogamous mateships which last for several years; the male, nevertheless, is believed to indulge in accessory promiscuity, seeing that he copulates occasionally with unmated females. Further investigation of rodents living in colonies will perhaps result in the

discovery of other species among which monogamous mateships last for several years.

Permanent monogamous mateships within a community probably occur among many of those birds which brood gregariously. Penguins, herons, wild guinea fowl, some species of sand-pipers, sea-gulls, sea-swallows, auks, guillemots, parrots, bee-eaters, swifts, certain birds of prey (e.g. the majority of the vulture species), ravens, starlings, some thrushes, the weaver bird, many doves, ducks, cormorants, all are gregarious throughout the year, and live in monogamous unions which, among many of the species named, probably last for several years, if not for life. Thus all species of parrots, so far as is known, live in strict monogamy throughout their lives. If one of the mates is shot the other (e.g. among araras) not infrequently allows itself to be caught. Herons in their brooding colonies are also strictly monogamous, and the same applies to the flocks of penguins which collect at brooding time, often numbering hundreds of thousands. In some colonies different species may possibly brood side by side (as do different species of vultures). Among many kinds of birds, even in large flocks, a pair of mates may be recognized by their devotion to one another's society. At brooding time too, birds which brood in colonies generally set out together, in large or small groups, on the quest for food, as anybody may observe, for himself, each year in the case of starlings. Rose-coloured starlings are monogamous, and nest gregariously. During the day the male feeds the brooding female; at night the latter remains on the eggs, while the males depart together for a sleeping place which is perhaps

several kilometres away. Sparrows are also monogamous and brood gregariously, and while the female broods the male from time to time betakes himself to the society of other males.

It used to be supposed that button quails (*Turnices*) lived polygynously ; this has proved to be erroneous, they are monogamous. Moreover among them, as among phalarope, the females are larger and more brilliantly coloured than the males ; here only the females dance and fight for the possession of the males, while the latter alone hatch the eggs.

Among the penguins already mentioned, at breeding time the brooding colonies, which sometimes contain members of more than one species, are traversed by innumerable pathways cutting each other at right angles. Each of the rectangles thus formed is taken possession of by a pair of penguins, and here the nest is built, either below, or on the level of, the ground. Nests below ground level are connected with each other by similar paths. Endless quarrels occur over the nesting place and the quadrangular space which surrounds it. The nest itself is made of collected pebbles, which the birds occasionally steal from one another. Murphy has described the gregarious life of the guano birds of the Peruvian coast ; most instructive photographs show the birds brooding, flying together, and engaged in other activities.

In the case of the small green black-capped parrot, as many as twelve pairs build their globular nests so close together as to give the impression of a solid mass of twigs ; each nest, however, has its own entrance and its own outer room and brooding chamber. The sociable gros-beak

(*Philetaerus socius*) nests, colony-fashion, in trees. Each pair builds and roofs its own nest, but the nests are so closely packed together that they resemble a single structure with a roof above, and innumerable entrances below. Each nest is used only once ; at the next brooding time the new nests are fastened underneath the old ones, so that the structure grows larger and larger, until, at length, it crashes to the ground.

House pigeons live and nest gregariously ; as pigeon-fanciers know by experience, from four to eight pairs at least must be kept at the same time, otherwise the birds fly away and join some other flock. In certain species, according to Whitman, the sexes do not recognize one another at first sight, but only by their behaviour ; homosexual inclinations and actions occur with males and females. Once mated the female pigeon is usually faithful ; this is less true of the male ; all the same, even if he does occasionally visit other unmated females, he is so far faithful to his mate that he assists in the preparation of the nest, relieves her regularly during the breeding period, and feeds the nestlings. The infidelity of the male may, then, be claimed as a case of accessory promiscuity. The male recovers from the loss of its mate much more quickly than the female. If the fancier attempts forcibly to re-mate the birds, they often go back to their original mate on the first opportunity. Nevertheless it would seem that among pigeons mateships are not life-long, but last only over a number of brooding periods.

Schjelderup-Ebbe has made a number of most important observations on the life, after mating, of gregarious wild

ducks. One female never attempts to decoy a mallard belonging to another. During the selection of mates the male approaches the female; but the latter does the choosing, that is to say she either avoids the approaching male or accepts his advances. If she accepts him a monogamous union is formed; if she does not the male turns his attention to other unmated females until his wooing meets with success. No hen bird ever allows herself to be forced into mating with a mallard. The superiority of one suitor over another does not influence the female in her choice. According to Schjelderup-Ebbe both male and female are strictly faithful to one another. Unmated males are always eager to waylay already mated females. If the mate is stronger than the new-comer he tries to drive off the latter; but in spite of this the intruder sometimes succeeds in treading the female, for once he is in the "pairing trance" no biting or pinching on the part of the rightful mate has any effect. If the new-comer is stronger, the dispossessed mallard does not dare to defend his partner, but merely sets up a loud outcry. (According to Schjelderup-Ebbe, the respective superiority and inferiority of one bird to another in a bird community is always perfectly well known to its members; see below under "pecking order".) When the hen bird begins to brood the mallard, according to Brehm, leaves her, and joins with other drakes to form special flocks, or even mates again with a second hen bird which has remained unmated. But when the ducklings have reached a certain age, the mallard again joins the female and her brood. The mergus often nests in colonies; in this case two hen birds, even if they belong to two different

species, not infrequently lay their eggs in one nest, brood in common, and share the work of feeding and caring for the young without making any distinction between their own and the other's offspring. Among a species of weaver bird (*Munia malabarica*) two couples often share a common nest in which both the hen birds lay their eggs and hatch them out. Supplementary mention may be made of the Brazilian anis (*Crotophaga ani*). Some half-dozen of the hen birds build a common nest and also carry out the incubation of the eggs in common, two or three birds sitting on the nest simultaneously, and being relieved from time to time by other mothers. But since I could not, from the literature on this subject, make sure of the exact nature of the mating habits of this species, I merely quote these facts for what they are worth.

f2 Polygyny

The tarpan, the primitive European wild horse, now extinct, lived in herds numbering several hundred head. Each of these herds was sub-divided into a number of families, each family consisting of a stallion and several mares; no stallion allowed younger stallions capable of reproduction, nor even an older rival within his harem. The stallions often carried off domesticated mares, and on this account the South Russian peasants used to lay traps for them. Among zebras, and South American horses reverted to their wild state, several stallions and their harems may join together into more or less loosely organized communities; but even in this case the property rights of each stallion are strictly respected.

Some authors have given highly imaginative accounts

of those ape societies which are composed of several permanent polygynous mateships. On the basis of the information at present available, the organization of such a horde may be portrayed somewhat as follows. Among polygynous species any ape-herd of considerable size consists of several harems. By definition, every harem is composed of several females with their offspring and a number of half-grown males and females, held together by a full-grown male (called by these authors " the pacha "). The first care of every male is his own large family ; he looks after its safety, and makes sure that his more or less numerous wives remain true to him (Brehm, vol. 13, p. 575). Those of the latter who commit an act of infidelity are cuffed and pulled about by the " pacha ". In these polygynous families it seems that only the females, not the males, carry the young about. Several families, each led by its " pacha ", join together to form larger bands ; the leaders then make it their common task to guard the horde, in which they may relieve one another. The defence of the horde against external enemies is undertaken by all the " pachas " together. Since in every herd of apes constant quarrelling is the general rule, dissensions may also arise between these leaders. Each band lays claim to a special area. At night the apes usually huddle close together and keep one another warm.

Contrary to a widely accepted belief, all serious writers agree that promiscuity is never the general rule in a horde of apes ; promiscuity as an accessory phenomenon does, however, occur. Let me seize this occasion to emphasize once again that apes do not deserve the imputation of abnormal sensuality (Brehm). Adult males retain their reproductive

powers throughout the year, and the female menstruates every month ; this, and the protracted helplessness of the young, certainly contribute to hold such polygynous mateships together. Baboons, especially, live in groups led by several " pachas ", each accompanied by his harem (Schillings, 1905, p. 393), and this is probably true of howling monkeys (*Myetes*) as well. But even in this species, a " pacha " and his harem occasionally form an independent family. Hordes composed of different species of long-tailed monkeys are not rare. But even when every member of such a group follows the same leader, it is, nevertheless, certain that he does not lay claim to every female in his horde. In spite of the fact that only one such leader is present, given a sufficient number of individuals, here again a number of polygynous mateships may be formed within the horde. Now there are also hordes of monkeys all of whom belong to the same species, which are led by one ape alone, even though the horde contains several other full-grown males. So far as I could gather from the literature on the subject, it is supposed that, in these hordes, the leader claims all the females for himself. It is, however, possible that, as with a horde composed of different species, the " chief " possesses his own particular harem within the horde, and that the same applies to each of the other males. A further possibility, not to be summarily rejected, is that the stronger male, but he alone, may encroach with impunity upon the harems of the weaker, just as among ducks, according to Schjelderup-Ebbe, only the stronger treads the mate of a weaker one without meeting with opposition on the part of the admitted owner. All these are obscure

points where monkeys are concerned ; it is very much to be desired that some light should be shed upon them.

a2 Relations between Parents and Offspring : Families

A family may arise out of a mateship, but this does not necessarily happen. Many animals, even those which unite in seasonal monogamous mateships (fishes, amphibians, reptiles), abandon the eggs after they have been laid, and concern themselves no further with them. A distinction may be drawn between (*b1*) parent families, (*b2*) father families, and (*b3*) mother families, to accord with the cases in which both parents, or only the father or the mother, remain with the offspring. If the young are abandoned by both parents, whilst remaining united among themselves for a time, they may be said to form (*b4*) a child family. When one or both of the parents guard the eggs, but not the young after they are hatched, we have a preliminary stage of family formation. Among many species the fostering of the brood is a complicated matter. The families may be seasonal or perennial according to the period required by the young for development.

b1 Parent Families

Parent families occur among *passalides* and other wood-boring beetles, where the parents feed the larvæ, and watch over the chrysalis. Both male and female of the fish species (*Eupomotis*) guard the nest built to contain the eggs ; the young, after they are hatched, return to the nest every evening for three weeks, and both the father and the mother keep watch over them (Doflein, p. 587). It is not impossible

that in this case the example of the parents teaches the young to seek for food and avoid danger. Similarly among *Labrus*, and some *Cichlides*, both parents provide for and protect the eggs and young.

The parent family is also very common among birds and mammals. With monogamous birds the female usually builds the nest while the male only carries the material. Among weaver birds the male alone does the building, the female helps, at most, in the fitting out of the nest. Nest-building depends not on tradition and instruction but on a highly specialized instinct; for young birds construct a nest at the fitting season without ever having seen one before. The only difference made by practice is that the older birds build more cunningly than the younger. Generally speaking the nest serves only to shelter the brood, but with tits both the parent birds and their young often spend the night in it, even in winter.

The cock bird relieves the hen during incubation; often he brings her food. In many species both parents feed the offspring, and not infrequently carry away their excrement.

The parental instinct in birds is so strong that it is easy to foist eggs or nestlings not too obviously different from their own upon a couple to whom they do not belong. Substitutions of this kind even occur in nature; half-fledged nestlings which have lost their parents will sometimes fly to a strange nest, possibly that of another species, and are there fed, together with the nestlings already present, by the parents of the latter. It is well known that the hen cuckoo lays her eggs in the nests of other birds and

practically never broods herself. The fact that cuckoos' eggs found in the nests of hedge-sparrows, water-wagtails, etc., always in the same degree resemble those of these species, depends, according to Rensch, upon the fact that the owner throws all too dissimilar eggs out of the nest. Thus the cuckoo trades upon the parental instincts of the birds whose nests it invades. The newly hatched and still sightless cuckoo ejects the offspring of its foster parents from the nest with movements of its wings and back, but in spite of this the parent birds invariably look after the interloper until it is fully fledged. Thus we have the following anomaly: the singing-birds worry the full-grown cuckoo just as they do other enemies, e.g. birds of prey and owls, by emitting piercing screams when the female cuckoo approaches their nests, whereas their all-powerful parental instinct prompts them invariably to tolerate the egg or tend the young bird left with them. A South American duck (*Metopiana*) lays its eggs, like the cuckoo, in the nests of other birds, namely in those of coots, sea-gulls, etc., and never, apparently, builds a nest of its own.

If one of a pair of brooding birds dies the survivor often brings up the brood alone. But the males of many birds of prey cannot do this. With house pigeons, if one mate perishes whilst brooding the other very soon desists from the task. The parent birds of some species (ostriches, peewits, corn-crakes, larks, partridges, ducks, etc.) entice an enemy away from the nest by a cunning retreat, pretending to be wounded, limping, etc.

If the hen bird lays a second batch of eggs, the cock very often assumes entire charge of the first brood. Young

swallows share with their parents the task of feeding the second brood (Groos, p. 12 ; Brehm).

When the young birds are fledged they are taught flying and other accomplishments. Often the old birds perform flight movements in sight of the nestlings, entice them out of the nest by dangling food in front of them, or push them over the edge of the nest and catch them again, if necessary, in mid-air. Crested divers take their chicks down with them when they dive, tucked under their wings. As soon as young wall swifts are able to leave the nest the parent birds may be seen flying with them through the streets of our towns, uttering piercing cries ; by this means they are taught to fly and catch insects. Male and female falcons teach their young to capture prey. One parent on the wing drops the prey, and the young must catch it in full flight ; if they miss it the other parent, flying under them, catches it before it touches the ground, carries it up again and lets it fall once more from above the young birds. These exercises serve also as practice in flying, the young birds imitating the example of their parents.

When nestlings are full grown the parents very often drive them from the nest, on the other hand they may remain under the protection of the parents even until the second year, as happens in the case of some ducks. The parent gray goose cannot fly, consequently the young do not migrate in the autumn, but remain with the old birds during the winter (Doflein, p. 692). The male partridge at first guards his family alone ; later, however, when the young males are sufficiently developed, they take it in turn to keep watch over the brood.

Among polygynous birds the care of the young usually devolves upon the female, but in the case of the Nandu it is undertaken by the male.

Among many mammals the father helps in protecting and instructing the young ; it is probably in the nature of things that the male of a monogamous species takes a greater interest in the young than the male of a polygynous species. In those mammal species where development is especially slow two or more litters may remain under the care of their parents at one and the same time.

Among some beasts of prey the father lives for a time with the mother and the offspring. Thus the male lion is said to help in the procuring of food, and to defend both its mate and its offspring. Some beasts of prey, while they are still young, learn how to hunt under the guidance of their parents ; in the case of lions this period of instruction is said to last a year and a half. Male foxes, contrary to earlier views, also defend their mate and their offspring. On the other hand it is uncertain whether the male wolf helps in the rearing of the young.

Among monogamous *Ungulata* (wart-hogs, certain red deer, antelopes, gazelles etc.) the male helps to defend and instruct the young. In respect of wild rabbits we have two contradictory assertions, namely that the father protects the young and the mother hides them from him ; perhaps it is a case of the habit varying with the district. Among *Ungulata* living in polygynous permanent families the male leader always protects the whole harem, including the young.

With both polygynous and monogamous apes the father

guards the young ; often the mother, as far as is possible, keeps the offspring away from the father ; in the case of *Callithrix*, however, we saw that the female sometimes induces the male to relieve her, temporarily, of her burden, which he does willingly. In certain ape species, when kept in captivity, the father assumes the care of the young on the death of the mother (Brehm, vol. 13, p. 561). Proof that apes are by no means sexually unrestrained is to be found in the fact that the male of a polygynous species may care for his female alone once she has become a mother, and for her offspring, taking thenceforward no notice of other females (Brehm, vol. 13, p. 591). The mother chimpanzee carries her young about until their third year. The first attempts at walking alone are prompted by the mother placing the infant on the ground, whereupon it utters piercing cries and immediately runs back to her. But the mother puts the frightened infant down again and again, until at last it gains courage to crawl a few paces. According to von Allesch, the mother chimpanzee teaches her offspring to crawl in the third month ; standing opposite to it she holds it by one paw and forces it to follow her on three legs while she goes backwards ; or she puts it down beside her and leads it stumbling along. Orang-utan females kept in captivity have been observed to teach their offspring to eat bread by chewing it before them. Pfungst never observed that the females of other ape species teach their young, as they are commonly asserted to do. According to him, too, games between the young and the old are always started by the young. Yerkes mentions that mother apes will sometimes carry about a still-born infant for more than a

month, until all that remains of it is an unrecognizable shred of skin.

b2 *Father Families*

When the father alone takes charge of the young, a father family is formed. In a certain sense such a family may be said to have been formed when the father guards the eggs after they have been laid, even though he takes no further trouble over the offspring when they are hatched, as occurs in the case of the grass frog. The male of *Alytes obstetricans* carries the eggs about with him in a long string wound round his hind legs until the larvæ emerge, and defends these strings against marauders ; but the larvæ are left to themselves. In contrast to this the male *Rhinoderma* not only carries the eggs in his gular sac but the young as well, until their metamorphosis is complete, while among some other frog species the tadpoles are carried about on the back of the male.

The male stickleback builds a nest and induces a number of females to lay their eggs in it, in the way described above. If his nest is taken from him he suffers himself to be pursued and ill-treated by others of his own species, but as soon as his nest is returned to him he immediately puts all his assailants to flight, and returns to the defence of his nest again (Deegener, p. 237). His psychic condition strongly affects his bodily appearance ; when thus dispirited, he pales, though normally at pairing times his body is a bright scarlet. Not only the eggs but also the young, after they have hatched out, are guarded and kept together by the father ; runaways are swallowed and brought back to the nest. It is probable that young fish, forsaken by the father,

attach themselves to families still led by the male parent. A few other fish species may be named ; the male *Protopterus* defends his offspring as long as they remain in the nest ; the male *Macropodus* and that of allied species seizes in its mouth young which have strayed from their foam nest and brings them back to shelter ; the male of *Arius* carries both eggs and young for a time in its mouth, and later on, if danger threatens, hides them there again ; the male *Amia* leads its family of young for four months.

b3 Mother Families

It is more frequently the mother than the father who, unassisted, guards the young. The females of some species of leeches carry their offspring about for a time ; the young attach themselves to the body of the mother with their suckers, and if detached, always return to her. The female of certain species of bugs guard their eggs and their young. The female earwig (*Forficula*) guards eggs and young in a hole which she digs herself, and collects them together again if they get scattered. The female mole-cricket (*Gryllotalpa*) digs a hole for its eggs and guards them and, for some time, the young as well, although this does not prevent her from gradually devouring a certain number of the latter (cannibalism is, indeed, of very common occurrence in the animal world, see below). With many arthropods, specially among crayfish, but also among spiders, the mother carries the eggs about with her ; in the case of spiders the mother may even guard the young. Among *Lycosidæ* and scorpions the young take refuge on the mother's back. The female scorpion is said actually to catch prey and tear it into

pieces for its young. In the case of *Copris*, a dung beetle, the female remains with the larvæ during their metamorphosis, and is even supposed to assist them to emerge from the chrysalis. The female of some species of cuttlefish (octopus and other allied species) watches over the eggs, and passes a constant current of water over them from her funnel.

Mother families also occur among fishes. The female of *Heterotis* lays her eggs in a nest and later leads the swarm of young. Among some species of *Cichlidæ* the female carries the eggs and the young in its gullet; the young afterwards swim near the mother, and when in danger collect round her head, or are sought out, one by one, and sucked into her throat again.

The female marsupial frog carries its eggs in a pocket on its back until the young tadpoles emerge. The female pipa toad carries its young in a pouch of skin on its back until their metamorphosis is completed. Female crocodiles watch over their eggs, help the young to emerge, and lead them to the water. The female alligator protects its young even after this point. Female pythons guard their eggs; whether they also protect their young is not known.

Mother families are the rule among polygynous birds (except in the case of the Nandu). Chickens, for instance, learn from their mothers how to avoid danger, how to pick up food (Morgan), and (according to other writers) their peculiar method of drinking.

In the case of the feline beasts of prey the mother drags small living, or half-dead animals up to her young, provided that the father does not also take his share in rearing them

(see above). Among the majority of beasts of prey one of the chief cares of the mother is to keep the father away from the offspring to prevent him from devouring them. She sets free her prey in the presence of the young, and by catching it they prepare themselves for future predatory exploits. Later on the mother takes her offspring with her on her hunting expeditions, and it is only when they have themselves mastered the art that they leave her. Such instruction may require months, for though the predatory instinct is innate, it is perfected only by teaching. Young foxes are taught by the mother in a similar fashion. Female polar bears and seals carry their young to the water and teach them to swim. Solitary mother families are found among some of the *Ungulata* (e.g. among elks). Where the larger gregarious mammals are much pursued, the herds may sometimes split up into mother families. Thus Schillings (1905, p. 128) repeatedly saw herds of elephants consisting of a mother and six or seven younger animals of different sizes, very probably all of them children of the old female born in the course of the previous thirty or forty years.

A "mother herd" is formed when a number of mothers and their offspring unite into a society without the fathers (see below).

b4 *Child Families*

If the children only, without their parents, unite and form a society, a "child family" or brotherhood is the result. Processionary caterpillars, and other species of the genus *Thaumatopea*, which have emerged from the same

mass of eggs, remain together permanently. In their migrations they form the well-known "processions". One caterpillar leads the way, after it two or three others, and then the rank and file in threes and fours. The insects creep along in an unbroken chain, and if this chain is ruptured at any point the alarm thus created may spread to the leaders, and the procession comes to a standstill until the broken connexion is re-established. Deegener is, in my opinion, quite wrong in calling such a gathering an association and not a society, giving as his reason that "no positive advantages can be proved to result from it" (1918, p. 86).

Hyponomeuta caterpillars build a common dwelling nest. If scattered, they strive, according to Deegener, to reunite and build another, whereby various different "child families", i.e. the offspring of different parents, mingle without hesitation, even when there is a considerable difference in their ages. Small bands of scattered caterpillars tend to attach themselves to larger ones, searching aimlessly about for them, since they are unable to perceive their fellow creatures beyond a certain distance. If one caterpillar is kept in solitary captivity it builds a nest alone, and appears to suffer no appreciable effect from its isolation. Among *Malocosoma* (Deegener, 1920) the caterpillars, even of different species, unite to form a "child society". These insects often combine permanently with companies of caterpillars belonging to another species.

Young fishes not infrequently form "child families"; but families so created mingle with other members of their own species the moment they meet, irrespective of whether they are the offspring of the same or of different parents.

Herrings which have hatched out simultaneously remain permanently united, and thus form swarms differing from one another in the age of their members; these swarms may mingle for a time, but each always re-issues intact from the mass. Young pythons keep together at first in a kind of community, later becoming solitary, like the parent snakes.

"Child families" are also found among mammals; they might perhaps be more accurately designated "child herds" or herds of adolescents. Thus young cachalots sometimes live in groups of their own until sexually mature. Young roes stay with the mother until the next rutting season; she then drives them away and they often unite to form herds of their own. Among wild reindeer the young males and females, not yet capable of reproduction, join together into herds of considerable size led by an old unmated female.

a3 The Behaviour of Animals Debarred from Breeding

Among many social mammals, but also among birds and reptiles (emerald lizards), old males are sometimes found living in solitude. Some authorities would consider mammals living thus as former leaders and harem-owners expelled by rebellious young males (Oedipus!). But since such solitary animals are found in so many different species it is probable that, in some cases, at least, weakening of the sexual impulse and a desire to abandon the restless life of the herd are important factors in their behaviour. In the mammalian species solitary animals are encountered among

apes, elephants, buffaloes, deer, antelopes, giraffes, hippopotami, kangaroos, rodents, etc.

In the case of the gnu, males in their prime have been seen to expel older males from the herd and keep them away from it permanently (Schillings). The latter hold themselves aloof, like outposts, at a distance of a few hundred paces from the herd and give warning signals when danger approaches. Very old steers eventually separate themselves entirely from the herd and live a solitary life for the remainder of their days. Among bantins, the younger generation of bulls are said to make common cause against old steers and expel them from the herd.

Old males living unmated either keep strictly to themselves, or else seek out others in a like condition, whether the latter belong to their own or to another species. Old bull gnus, for instance, live in groups of twos and threes, and so do old bull elephants. Schilling saw two old bull elephants and an old male giraffe living together for weeks.

Among polygynous species there are always, in the nature of things, a large number of males which—for a time, at least, and possibly all their lives—are precluded from coition. Among sea-lions, and their allied species, where the male always collects a large harem, the excluded males gather together in two separate groups, one consisting of old, expelled, or wounded males, the other of the younger males, the "bachelors" as yet precluded from coition by the lords of the harems. Among guanacos the sexually mature young males expelled by the herd leader, foregather with others of their own age and with immature females. Young male vicunas remain with the mothers until they

are full grown ; then, however, the whole herd of females unites to drive away the now sexually mature males with bites and kicks. These males then form herds of twenty or thirty head to which other unmated solitary males attach themselves after they have been defeated by a rival. These herds have no leader, and, at rutting time especially, live in a state of continuous quarrelling. Such " bachelor " herds are found among some species of apes, deer, antelopes, gazelles, and buffaloes. The troops of geldings found in South America, which herd together in companies of their own, and keep away from the harems, are, in a certain sense, " bachelor " herds. In Cape Colony adult male long-tailed monkeys are often met with living alone, and this has been taken to mean that they have been driven out of the herd by the " pachas ". Among migratory birds, those which, for some reason or another, have not paired, always return very early to their winter quarters.

Animals prevented from pairing and breeding often try, nevertheless, to satisfy their brooding instincts. Unmated guillemots are always to be found on the cliffs monopolized by this species for brooding, and they pounce upon any eggs temporarily abandoned by the parent birds, and brood for a little while. In Paraguay, female mules, though sterile, sometimes steal foals from mares ; they mother these foals, tender them their dry udders, etc., but the foals, of course, quickly perish. The German expression " ape-love ", connoting harmfully exaggerated parental care, does not, according to Brehm, refer to an ape mother's anxiety for her own offspring, but to the parental instinct which shows itself in childless apes ; these will appropriate the offspring

of another female (sometimes belonging to a different species, or even the young of cats and dogs), thus gravely imperilling their lives, the would-be mothers having, for one thing, no milk to offer. Generally speaking, certain mammals, and also certain birds, show a striking tendency to adopt and tend anything young, more or less regardless of its size (Groos). The parental instinct is, therefore, awakened by whatever is young, awkward, or in need of help, and not by any special smallness of the animal. This instinct shows itself most clearly in individuals prevented, by some cause or another, from breeding.

2 The Behaviour of Seasonally Reproductive Species outside Breeding Time

The behaviour of seasonally reproductive species during the period of sexual inactivity varies greatly. Either the couples live in solitary monogamous mateships throughout the year and are abandoned by their children as soon as these have reached a certain stage of development (as in the case of some birds); or the family, consisting of father, mother, and children, remains united until the next pairing time in the following spring, possibly living gregariously, meanwhile, with other families. Alternatively the mates may separate after the breeding period and unite with others of their own sex to form male and female communities. Either the old mates reunite in the following season, or new mateships are formed from year to year. Whenever the females live in a herd of their own, accompanied by their young until the following spring or later, they form a "mother herd".

a1 Cases in which the Sexes Live Together

Some fishes, living for a time in solitary mateships reunite after breeding time into large communities (e.g. the grayling, *Rhodeus amarus*). This is also true of some reptiles, e.g. lizards. Among sticklings and other species the males isolate themselves at breeding time, although outside this period they live a gregarious life.

Birds frequently assemble in flocks after the breeding season is over, sometimes only to fly from one haunt to another (in northern regions, titmice and some finches, in warmer latitudes, flamingoes), sometimes to migrate to more temperate zones. The migratory birds of the northern hemisphere naturally fly south in winter, those of the southern hemisphere north. Before they set out large crowds of them are seen to remain several days in the same spot. They migrate, according to the species, either in large masses of no particular shape, or in rows or in wedge formation; in this last case the bird at the apex (whether male or female) is frequently relieved. Birds which have travelled together remain more or less united in their winter quarters. Migration is instinctive ($C > V$), for birds captured as nestlings and kept in isolation grow very restive as the migrating season approaches. It is not habit but instinct which determines the travel routes, at least among those species where every bird, including the young ones, sets out independently (see below).

With the settled warmth of spring, the birds break up their winter gatherings, whether these be formed for migrating or merely for feeding. The pairing of unmated

birds is not a simple division of the winter flock into separate couples ; rather the gregarious impulse disappears and the mating impulse asserts itself more and more. Long-tailed tits (*Acredula caudata* and *rosea*) form societies during the winter which consist mainly of single families, i.e. parents with their young. In early spring these societies break up, and solitary unmated males are seen flying round alone in eager search for a mate, which, when found, they escort to the future nesting place (Haecker, p. 47). If, after their return in the spring, migratory birds are taken unawares by a recurrence of wintry weather, a number of couples living in the same area may be seen momentarily reunited in a common search for food (Haecker, p. 35).

In certain mammal species males and females unite to form societies between one pairing season and another. Thus wolves, jackals, and hyenas live in hunting packs. I was able to see for myself, in the spring of 1915 after the Russian invasion of East Prussia, near Eydtkuhnen, that the instinct to form a hunting pack can be reawakened even in the domesticated dog. The district had been forsaken by its inhabitants, many farms had been burnt, and the cattle, and most of the dogs had perished. A few dogs, however, survived, and had formed themselves into packs of about a dozen which hunted over the fields like a line of infantry in open formation. It was a strange sight to see these packs composed as they were of dogs of all breeds, colours, and sizes, engaged in such a pursuit. Not one of these dogs had ever learned, either through tradition or upbringing, to hunt in this open formation ; but an ancient instinct prompted them, in their necessity, to form these hunting packs.

Among gregarious mammals the sexes very often separate after pairing time; nevertheless, among *Antilocapra americana* and saiga antelopes the two sexes are found living together throughout the year. The same thing occurs in the case of mammals living in colonies; the males and females do not separate. Many rodents, and also coneys (*Procapra*), live together in this way. Within such colonies the animals, alone (ground squirrels), or in couples (wild rabbits), dig a number of separate holes and burrows which are sometimes connected with one another, or several individuals may build a common dwelling. Dormice, alone or in companies, build ingenious nests in undergrowth; jerboas, and their allied species, wombats and opossums, live gregariously in holes which they dig themselves. Vizcachas and beavers live in colonies, the inhabitants of which are in close connexion with one another.

a2 Cases in which the Sexes Live Apart

The number of social species in which the sexes live apart, except at pairing time, is by no means small. It is, indeed not at all an infrequent occurrence for males on the one hand, and females on the other to form separate herds. If the females are accompanied by their young, a "mother herd" is the result. It is worth noting that societies composed of one sex only, and formed for no sexual purpose, are not restricted to man alone, but are also common among animals.

According to Schillings, for instance, among many antelopes the herds divide according to sex between one pairing time and another; it is true that a few bucks are

occasionally found in the herds of females. Wild sheep, bouquetins, and other *Ungulata* likewise live, after the pairing season is over, in herds composed of one sex only. Among African and Indian elephants, too, the sexes form herds of their own, the herds of females being led by a female and accompanied by their young. In years past herds of several hundred head were often encountered, but they were the result of temporary alliances between several different troupes. In more recent times, according to Schillings, the sorely decimated herds of East Africa probably no longer maintain the separation and classification of their societies according to age as strictly as in the days when they were more numerous. If a herd of males and a herd of females chance to unite, the separation of the sexes is usually maintained, this being especially visible when the herd is resting. Closer relations between the sexes occur only at breeding time, when a male temporarily takes possession of a herd of females to form his harem.

The bisons, which at one time were found by the million in North America, did not live in mere disorderly mobs. Every herd, however large, showed itself, on close inspection, to be composed of separate bands, each containing from six to sixteen bulls or thirty and more cows; the bands of females were led by young males, and each band of males had also its own leader. In a large herd the troops of bulls formed an outer ring, whilst the cows herded together in the centre. Bison on the march, or grazing, generally moved in Indian file. It is said that at rutting time the herd did not divide into couples or harems; nevertheless, the order described above must then have temporarily suffered con-

siderable disorganization. Among seals, during the period of sexual inactivity, the sexes are encountered in separate herds. The females are accompanied by their young, and sometimes by the "bachelors", i.e. males which did not succeed in mating. With Virginian deer the old males unite in herds of their own after rutting time, whereas the young males join the herds of females.

In some species the females live together with their young in "mother herds", the younger, sexually mature males form herds of their own, and the older males live as hermits, seeking the herds of females only at pairing time. This is true of wild pigs, red deer, and fallow deer. Although bats are generally extremely social animals, after pairing time the male lives alone, and the females form swarms of their own in which no male has ever yet been found. Shortly before the outbreak of the great war, according to Brehm, in Bialowicza herds of female bison (*Bos bonasus*), an animal now extinct in its wild state, containing from ten to twenty head, were always led by an old cow and accompanied by two or three bulls. The younger bulls lived in herds numbering from fifteen to twenty, whereas the old bulls lived by themselves. Females were rarely encountered singly, and if they were it was probably as a result of the decimation of the species. At rutting time the old bulls joined the herds of females, and violent battles were fought for the possession of the latter. Other species of buffaloes are said to have the same habits. Among elks, in the winter, the males and the younger animals unite into herds, containing at the most fifty head, while the females often keep to themselves, each with its own offspring. Typical "mother herds" are found among

some whales. Thus the cachalot appears in so-called "schools", numbering twenty or thirty animals, and entirely composed of females and their young; one old male acts as leader, called by whalers "the schoolmaster". Several schools may unite, each with its own schoolmaster. Schools of sperm whales have been seen, led by a female, and never accompanied by a male. In the case of the unsocial otter (*Lutra*), several females with their young often unite to form a "mother society"; in the same way sportsmen occasionally encounter two or three lionesses and their young hunting together.

Some species of birds, when migrating, divide according to age and sex; this habit has already been mentioned in connexion with chaffinches. In certain species old males on the one hand, and females and young males on the other, join together. It is common for the young birds to leave first, being followed a month or two later by the older birds, and last of all by the oldest males. In the spring this order is reversed. A typical instance of this is furnished by the starlings in Heligoland, whose period of migration extends from the end of June to December (Gaetke).

Wild turkey cocks unite after breeding time in societies of ten to a hundred, under the leadership of an old cock, while the hens collect in flocks with the half-grown young. In the course of the winter these groups, originally determined by sex, nevertheless mix with one another, but separate again before breeding time begins. Hand-reared cock pheasants, which are polygynous, abandon their mates and form flocks of males.

Some fishes live in shoals divided according to sex, e.g.

Leuciscus rutilus. When salmon come up from the sea, the sexes travel separately ; the shoals of males appear first, and are followed by the females ; it is said that they travel, like some birds, in V-formation.

a3 Societies composed of Different Species

We have seen that sometimes birds of different species brood together in the same colony. Other animal species, too, are found, especially at other than breeding time, living together, or with species whose rutting period is uninterrupted. We can here disregard those symbioses where the partners either exchange nourishment, or the one partner receives protection in exchange for foraging. We will only consider those cases where animals living their natural life unite mainly to satisfy their desire for companionship. We shall very soon discover that such societies may also possess biological significance. The links binding their members together are of varying strength, and consequently they must sometimes be classified rather as associations than as societies.

Different species of dolphins form troupes led by one individual ; whales sometimes accompany ships, prompted by their " following instinct ". Antelopes of different species occasionally mix with one another ; the reed buck, which always keeps to itself, is an exception. The Peruvian prong-horned antelope joins herds of tame cattle, as does the elk. Wild zebras follow domesticated horses and graze among them. Gazelles mix with herds of cattle. Wild asses, different antelopes, yaks, and scattered horses

are sometimes seen together. Wild buffaloes associate with elephants.

Zebras live amicably with different species of gazelles, and with crested cranes; these cases have sometimes been named "mutual assurance societies", for the long-legged birds in question are guided by sight, the four-footed beasts by scent, and it may well be that what escapes the "eye" is detected by the "nose". How far experience and tradition play a part in these societies is not known. Similarly antelopes and ostriches sometimes remain for hours in the midst of a troupe of baboons (Schillings). Large flocks of *Ciconia abdimii* and white storks (*Ciconia alba*) often hunt grasshoppers together, as do white storks and marabouts. Stresemann has given a detailed account of the occurrence of bird flocks composed of different species.

In conclusion we may mention the herds of apes already described, which are composed of different species. Some apes, however, avoid those of other species, and two species of baboon, *hamadryas* and *gelada*, quarrel whenever they meet, shrieking and bellowing at each other, though they seldom actually come to blows.

VI SPECIAL ANIMAL SOCIOLOGY (*continued*)

B INSECT STATES

Insect states must be given a place apart in the sociology of animal species, for they are social structures of such complexity that they cannot be ranked with the animal societies already considered. Animal states exist only among insects; they possess, in consequence, certain common characteristics, however much they may differ in other respects. Thus they are always spatially circumscribed by the dimensions of the nest; further their members are always morphologically and psychologically highly differentiated, and are, in general, inconceivable apart from the community into which they are born. It is perhaps not inapt to regard insect states as families, or "super-families". A bee-state would then be a mother family, and a termite state, in its simplest form, a parent family. But complications appear when, as among certain ants and termites, several egg-laying queens, or royal pairs, as the case may be, are present in the same community; or when insects of different origin unite to form one community, whether by reason of a slave raid, or in consequence of the adoption of a queen, or as a result of the peaceful fusion of two races. Any attempt at a rigid classification by relationship thus leads to great difficulties, and sometimes even to the separation of things in reality inseparable.

An insect community is divided into " estates " or castes, of which, in the simplest cases, there are three, males, females and workers. These estates or castes do not bear the smallest resemblance to those of human societies, for in these latter, to put it briefly, castes and estates continue to exist because they breed within themselves; thus the son is born into his father's caste. But in insect states the males and females form separate castes, and there is, in addition, a caste of workers, ordinarily sterile but reproducing themselves in certain special circumstances. Besides the workers some ants and termites have a special soldier class, also predominantly sterile. These two castes may fall into sub-castes, that is to say, into large, medium sized, and small workers and soldiers. It is characteristic of these insect castes that they do not breed within themselves, but that they all descend from the female. The term " caste " is, consequently, not very happily chosen.

These insect states are held together essentially not by tradition, but the extraordinary certainty of the instincts with which their members are endowed. The newly hatched individual knows from the outset all the essential things it must do or leave undone; it never requires any kind of tuition (C, therefore, largely outweighs V). It is this above all which is so puzzling in the study of insect life.

Our chief problem, in this connexion, is as follows: how is it that, in insect states, the activities of every insect are almost invariably directed towards a common end? Who, at the proper moment, gives the word of command? An actual leader is lacking; to call the female " the queen " is totally misleading, she is usually no more than an egg-

laying machine, at least when the size of the community increases. Among white ants the "king" has no other function than that of fecundating the female from time to time. We are driven, then, to the following supposition; in spite of some individual differences in temperament and native endowment, the members of an insect community are, in general, psychically so closely attuned to one another that when one insect gives a particular signal this is sufficient at once to induce in all the rest a like series of movements. Likewise when the same external stimulus affects them, they all behave either similarly, or in a manner dictated by a common purpose. That which prompts this organized activity is, therefore, neither a command nor an intellectual operation, but a common store of instincts which every individual possesses, and their mutual adaptation to one another, which we might call an interlocking of instincts.

1 Rudimentary States: Humble Bees

The majority of wasps and bees are solitary; only a few are social. In the solitary species relations between individuals occur only when male and female come together in the act of coition. Mother and children, as a rule, know nothing of one another. It is true that some solitary bees show a rudimentary form of social life, since they nest in colonies and make common cause against aggressors, and also sleep and hibernate together. Some solitary wasps hunt in common, although this does not prevent them from robbing one another on the return journey. (For other rudimentary types of society see von Buttel-Reepen, Friese, Peckham, and Wheeler.)

The humble bee state lasts only a year. The fecundated young female (the queen) winters alone, and in the spring builds a nest by herself. She maintains relations with her offspring by subsequently reopening the previously sealed waxen cells in which the eggs were laid, and feeding the young. This nourishment is, however, insufficient, and the young emerge as small female workers, only able to reproduce themselves by parthenogenesis. Thenceforward they do all the work, and thus play the same part as that of the workers in communities of bees, ants and termites. The queen thenceforward confines herself to laying eggs. There is a division of labour among the female workers : some only look after the larvæ, others build, and others again fly abroad, collecting food ; sometimes honey is brought in and stored. Workers whose nest has been destroyed will take shelter in other nests, possibly even in those of a different species. Later in the year, as a result of better feeding, large females, capable of reproduction, and males, are hatched out, the latter from the unfertilized eggs of the queen and the workers. Coition takes place in the open air. In the autumn the whole community perishes with the exception of the young fecundated females.

A great deal of discussion centred at one time round the so-called "trumpeter" of humble bees. Early every morning a bee appears at the entrance of the nest and there produces a loud humming by the rapid beating of its wings. This does not, as was once imagined, serve the purpose of a reveillé ; the insect merely acts as a living ventilator, and if it is captured another takes its place.

2 Bees

The honey bee state may be described, at a certain stage at least, as a mother family (v. Buttel-Reepen, Jordan, Doflein, Deegener). At first the queen is surrounded by her sisters (the sterile worker bees) alone. These are later joined by her own children (males, females and workers), and at the end of the season her children only (i.e. workers) people the hive. Among honey bees the queen is never left alone, but is always surrounded by a swarm of workers, which guard, clean and feed her; she devotes herself solely to propagation. A well-stocked hive contains from 20-75,000 workers; they alone are equipped for foraging, and are degenerated and sterile females.

These workers build the cells for storing food and the cells for the offspring; the queen lays an unfertilized egg in each drone cell, and a fertilized egg in each worker and in each queen cell. She can either fertilize the egg as it emerges by semen contained in a special sac, or leave it unfertilized. For six or eight weeks she lays about two thousand eggs a day, and this daily output weighs twice as much as her own body.

The care of the brood and the entire economy of the hive falls to the lot of the workers. A special instinct for cleanliness prompts them to keep the hive clean, and besides this they clean themselves and each other. The young bees busy themselves within the hive, while the older ones (the foragers) fly abroad. Of the food brought into the hive, part is converted into an artificial food, part is consumed by the foragers themselves, and part is given to the other workers. Bee-bread and honey are produced

in this way. Honey is manufactured from nectar, and is prepared in the proventriculus, or crop, of the workers. The thickening of the honey takes place not only in the crop, but also in the cells to which it is brought, and which remain open for a time before being sealed; the necessary air supply is provided by a number of workers rhythmically beating their wings. Honey is produced both for current consumption and for storing in reserve. Bee-bread is made of pollen which some of the bees bring in and deposit in the cells, while others, whose activities are confined to the hive, pack it tight and seal it over. The foraging bees occasionally penetrate into neighbouring hives and steal honey. Bee hives with only a small population may suffer severely from such marauders.

The unfertilized eggs produce drones, the fertilized eggs females or workers. Whether a female or a worker is to be reared from the fertilized egg depends in the first instance upon lodging it in an appropriate cell, and then upon the kind of nourishment supplied to the larva. Each of the three different types of larva is provided with an appropriate diet by the bees tending the brood. Every young worker larva can be developed into a queen by the worker bees; they have only to transform its cell into a "queen-cell" and provide it with the food supplied to the queens. Like the larvæ, both the drones and the queens have to be fed by the worker bees, which supply them with chyle (bee-bread partially digested in the second stomach and regurgitated); the chyle is also used in feeding the young.

Every year from two to six queens are reared in succession. As soon as one is full grown she emits a piping sound in her

cell, and this throws the whole community into a state of the greatest excitement. The old queen always attempts to kill the young one, but the latter is protected by a guard of workers ; she then forsakes the hive, accompanied by ten or fifteen thousand bees. This swarm attaches itself in a grape-like cluster to a branch, or some similar object, and subsequently settles in a new home which has been explored two or three days beforehand by a few bees acting as scouts or forerunners (unless, of course, the bee-keeper houses it by force in a new hive). The young queen left in the hive attacks the remaining queen cells and kills the females developing within them. The workers prevent this only if the hive is sufficiently populous to allow of the formation of a second swarm ; in this case the next queen to appear departs with a second swarm, and her successor sometimes again with a third. The queen finally left in possession of the hive never fails to destroy every female still in course of development. In any one bee state there is but one queen.

If the queen does not fly out with the swarm the bees return to the mother hive ; this also happens if the queen perishes before any young larvæ have come into existence. If more than one queen (the old one and several young ones) flies out with the swarm, all but one are killed. Should the queen be removed, or die, the greatest excitement takes possession of the hive. Each individual emits a peculiar and characteristic sound (the mourning cry) so that the loss is immediately known all over the hive. If a substitute queen is introduced she is at first treated with enmity, but after a day, or a day and a half, she is accepted. If, on the death of a queen, the hive remains queenless too long, many of the

workers lay unfertilized eggs, and any new queen is rejected ; the stock then quickly perishes. Among stingless bees, the *Meliponæ*, the old queen does not depart with the swarm ; it is the young queens that fly off, surrounded by part of the community.

Among honey bees the new queen is fecundated during the nuptial flight by a drone in a single copulation, after which she returns to the hive. The remaining drones are subsequently destroyed by the workers. The massacre of the drones does not usually take the form of stinging them to death, rather they are driven by the workers out of the hive into the open air, and there they perish.

The smell of the nest serves as a mark of identification among bees belonging to the same hive. It is a blend of the smell of each individual and that of the nest in general (including that of the brood, the wax and the food). All strange bees which lack this particular smell are slain, for sentinels, stationed at the entrance of the hive (as happens among all other social insects), examine every arrival unless the numbers in the hive have too greatly weakened. If the bee-master wishes to provide a new queen for a queenless hive, he must first place her in the hive for a day or two, confined in a small wire cage, so that she may acquire the smell of the nest or that a mutual exchange of smell may take place ; otherwise she will be put to death.

3 Ants

Among ants several queens are sometimes found in the same state (Escherich, Forel, Wasmann, Wheeler, Doflein, and others). These may have come from different nests,

having combined together after fecundation. Sexually mature males remain in the community for a short time only, as they leave the nest for ever after a few days, pair, and die. The number of workers which a nest may contain varies from a few dozen to several hundred thousand ; if the inhabitants of daughter colonies living in amity with those of the mother nest are included in the reckoning, the whole population frequently numbers several, or even many (up to one hundred) millions.

The workers, as with bees, are specially adapted, sterile females ; they are, however, wingless, unlike the normal males and females. A far-reaching division of labour is the rule among the workers ; their apportioned tasks are either feeding and cleaning the larvæ, building, or foraging. The younger ones are first kept occupied within the nest, and only the elder ones are sent abroad. The males seldom perform any social duty, though they do, for example, help in carrying the young in changing from one nest to another ; the females, on the other hand, often assist in the work of the community ; they help in building, and in times of danger carry larvæ and chrysalides. The division of labour is, in some species, connected with a morphological polymorphism in the workers ; two, three, or more types are then found. Thus in the case of *Atta*, the middle-sized workers are leaf-cutters, the large ones leaf-grinders, and the smallest tend the fungus-gardens. Soldiers, again, are a special type.

The excitement of the males and females preparing for the nuptial flight spreads to the workers ; during this time practically no work is done. The males and females do not depart all at once, but gradually. The inhabitants of

different nests collect in great swarms in the air. There, during the nuptial flight, enmities based upon a difference of nest smell cease to exist. The queen may be fecundated by more than one male. After her fecundation she throws off her wings and proceeds to found a new colony, sometimes combining with other females for this purpose. She lays eggs, and nourishes herself and the first born larvæ upon some of the eggs she has herself produced ; afterwards the rising generation of workers undertakes each its appointed task. When several queens found a colony together they live peaceably with one another until the first workers begin to appear ; after that, however, they commonly fight until all but one are killed. Should it happen that one colony contains several queens at a time when outward circumstances are unfavourable, all but one are slain by the workers.

There are certain species in which the female is incapable of rearing its own brood ; such a " dependent " queen takes refuge with a female of another species still possessing the power to do so, and leaves her brood to be reared by the latter. In extreme cases the workers, too, of the given species have lost the instinct to tend the young, and the work devolves entirely upon the workers of the second species. Alternatively a " dependent " queen has to permit herself to be adopted by workers who have lost their own queen, and with their help found her new colony ; or again she may steal a few chrysalides of another species, and rear them into worker ants for her own service. Sometimes a queen will enter a nest, kill all its full-grown inhabitants, and rear the larvæ into workers to serve her. Under certain conditions the workers also lay eggs. Very many eggs are eaten by the

ants themselves ; an ant will even eat the egg it has just laid.

The workers keep the nest scrupulously clean ; they feed and cleanse the young, and move them, several times a day, from one chamber into another of a more appropriate temperature or humidity ; the brood is housed according to age and size, in chambers which provide the environment most suitable to each stage of their development. The workers help the larvæ to spin their cocoons, and assist the full-grown insects to emerge from the chrysalis. In monogynous communities the death of the queen directly affects the welfare of the workers ; their ordered activities cease forthwith, and soon afterwards they die.

The building instinct among ants is highly adaptable ; the nests are, in consequence, particularly well suited to their surroundings. The foundation of a colony may take place as the result of the division of an existing state ; as many as sixteen hundred nests have been counted, all connected with one another, and possessing between them a population of many millions. It may happen that the friendliest relations between the inmates of one branch nest and another may change, in time, to enmity. In the course of a foray, ants of one species will take forcible possession of a nest belonging to another species. Every change of nest involves a procession of all the inhabitants carrying with them eggs, larvæ, and chrysalides

Weaver ants belong to the rare class of tool-using animals, and the tool they use is one of their own larvæ. They weave together leaves, each of a number of workers seizing a larva and using it in the process, whilst other workers hold the

edges of the leaves together. If the space between the leaves is greater than the body of the ant, as many as eight form a chain, each clasping its neighbour's waist with its jaws.

Individuals belonging to different nests, even when they belong to the same species, usually dislike one another; boundary disputes and thefts of stores frequently occur, the latter either during transport, or even from the nest itself; a war may be carried on between two nests for months; if neither side is vanquished, mutual toleration, or even friendship may ensue. Alliances between two different states are, indeed, not exceptional.

Some species hunt singly, others in swarms, e.g. the wandering ants; in the last case even rats and mice can be overpowered, and the flesh carried off in small fragments. Ants belonging to the same nest feed one another, the food being passed from mouth to mouth. Forel is, therefore, not altogether unjustified in describing the crop as a "social stomach", since one insect does feed another from it; only food reaching the digestive stomach benefits the individual itself, and Forel consequently called this portion of the alimentary canal the "private stomach". A hungry ant "begs" from a full fed comrade by striking it sharply on the surface of the body and the side of the head with its forelegs and antennæ and licking its mouth, whereupon the other promptly feeds it. A full fed ant will pass on part of its stores to others, and repeat the process several times. Those species which invariably employ slaves to do the work of the state are absolutely dependent upon the latter for food. The brood-tending ants feed the larvæ by vomiting a drop of fluid and letting it fall into their mouths. In

species where the larvæ possess solid jaws they are also fed with dead insects and the like. It is not yet known whether the workers develop females, and the various types of worker and soldier grubs, by varying the fluid on which these are fed.

Ants make provision for the future purely instinctively ; they are " breeders " in the sense that they rear and tend insects whose excretions are sweet to the taste. They lay up stores of seed and honey, and cultivate fungi ; and they help each other to carry home prey.

An ant " milking " an aphide, i.e. inducing it to excrete, taps the hinder portion of the aphide's body with its antennæ ; the aphid then lifts its hind parts and evacuates from its anus a yellowish drop of excrement, which is always rich in sugar. The ants protect and guard the aphides, and if necessary bring them into safety ; they build strong defences round them, carry their eggs into the nest in winter, and in the spring deposit the young aphides on plants. Young, newly hatched ants, without previous instruction, treat aphides' eggs in exactly the same way that the older experienced workers do, so that here there is no question of imitation. Root-eating aphides are kept by ants in suitable places within the nest itself. Some species of ants live entirely upon aphid excrement, and there are, correspondingly, some species of leaf- and root-eating aphides which cannot exist apart from their association with ants. Ants also devour the sweet excrement of some cicadas ; one species of ant builds special nests of leaves for the rearing of these insects. Some ants also feed upon the glandular secretions of the caterpillars of certain butterflies. The caterpillars are

guarded by the ants in question, and are dragged into the nest before the chrysalis stage in order that they may complete their metamorphosis undisturbed.

Honey ants (*Myrmecocystus*), found in Colorado, gather the sweet liquid which is exuded by the gall formed by *Cyriops tinctoria* on dwarf oaks. Any portion not immediately consumed is stored in the crops of special workers, the "honey-carriers". These, in the beginning normal young workers, are fed until their crops are so full that the whole of the hinder part of the body is swollen completely out of shape, and in this condition they hang for the greater part of their lives, immobile, from the ceilings of special store rooms. Should external supplies of food fail, the population lives upon the contents of the crops of the honey-carriers, allowing themselves to be fed by the latter.

The grain collecting species, which are found in warm countries, either seek together in the open air for seeds, or raid the granaries of other ant states and of men. The grain brought into the nest is cleaned and shelled by a special subordinate caste of workers; it is prevented from germinating by the dryness of the chambers used by the ants as granaries. The ants probably cause it to germinate by moistening it before they consume it.

Leaf-cutting ants are agriculturists in the sense that they cultivate a kind of fungus. The fungus gardens are situated within their nests, and the workers sow and tend a particular kind of fungus which they grow upon specially prepared soil. This fungus occurs only in ants' nests, and for this reason a queen, setting forth to found a new nest, must take with her a piece of the plant; this she carries in a pouch in

her mouth. The soil in question is prepared from fragments of leaves which the workers cut in the open air and then knead into soft lumps. This soil has to be frequently renewed and "weeded" to keep it free from other fungi and bacteria. The division of labour between the large, medium-sized, and small *Atta* workers has already been described. The *Atta* ants feed solely upon small tumours which appear on the fungi (the so-called "turnips"), which are very rich in albumen. Other species of ants besides *Atta* cultivate fungi, preparing the necessary soil from powdered wood and the excrement of wood-eating insects.

The worker ants clean and lick themselves and each other freely, and bestow a similar care upon the queen and the brood; this licking, however, cannot be attributed solely to a desire for cleanliness, but rather to the presence of certain skin secretions which induce this action. Refuse is taken out of the nest or brought to remote places within it and there sometimes covered with earth; dead ants are treated in the same way. These habits are the substantial element in certain highly imaginative descriptions of ant funerals and ant cemeteries.

If the nest is invaded the brood and the females are placed in safety in the deepest recesses of the nest, or else the inmates try to escape, taking the brood and the females with them. If the nest is inundated, the ants form themselves into living balls, with the brood and the females well protected in the centre. They broadcast an alarm throughout the nest by tapping one another with their antennæ, or by making knocking noises, or by using a special chirping organ with which they are equipped. The

inhabitants of a nest differ considerably from one another in temperament and courage ; the latter quality, as among all social animals, grows in proportion to the number of comrades fighting together. Their battle fury may rise to a veritable intoxication ; when this stage is reached, the ants throw themselves upon their infuriated companions, and hold them fast until the madness passes. An ant which has lost its way in the open is carried back to the nest by a companion. A sort of nursing of the sick unmistakably occurs among ants, any that are ill or damaged being tended and licked. Care of this kind seems, however, actually to be limited to cases which are not desperate, for the badly wounded, and some of the sick, are left unattended, or are carried off, without a moment's delay, to the rubbish heap. Ants, as I have said in the introduction, do not remove mites, or other harmful parasites from one another's bodies. Those most familiar with the habits of ants assert unhesitatingly that they play together. Judgments of this kind cannot be too circumspect, but the mock battles which take place among the inhabitants of one nest during warm weather, and when they are undisturbed, seem to be quite justifiably described as play.

A mixed colony arises when the workers of one colony receive into their midst a female belonging to another (adoption of a queen) ; it may also arise out of an alliance, or out of a conquest. The larvæ stolen on a well-organized " slave raid " are some of them reared, and some of them eaten. The so-called slaves are fully franchised " citizens " of the ant states in which they have shed their cocoons, and are not slaves in the sense in which the word is understood

when applied to human societies. The presence of these slaves in an ant state is not comparable with the employment of natives as soldiers and officials by civilized occidentals, for natives are always regarded, though in varying degrees, as citizens of an inferior order.

The genus *Polyergus* is an "obligatory slave-keeper", since the workers are only capable of stealing larvæ and cocoons, and depend entirely on their slaves for food ; without them they would die of starvation. The genus *Anergates* has only males and females, no workers. A female of this species penetrates into a *Tetramorium* colony, and is adopted by its workers, who probably even kill their former queen. A female *Anergates* produces only males and females, which have all to be fed by the *Tetramorium* workers. Gradually the *Tetramorium* colony dies out for lack of progeny, and the *Anergates* males and females in its midst are doomed along with their hosts. One or other of the *Tetramorium* females alone escapes death by migrating to another *Tetramorium* colony.

There are numerous insect species, the *Myrmekophila* (Wasmann), which live with ants. The individuals of these species are never found living together alone, but always associated with ants. These guests of the ant are sometimes so dependent upon this mode of life that they are incapable of existing apart from their hosts. Myrmecophilous insects can be divided into three classes. (1) Synecthrans, which are directly harmful to their hosts, and which these latter encounter with hostility. (2) Synoekites, whose presence either does not affect the ants in any way, or at least is neither specially harmful nor specially useful to them ;

these are tolerated by their hosts. (3) Symphiles, or true guests of the ant. All symphilous insects exude aromatic volatile substances ; these exudations take place from special hairs, the *trichomæ*, which grow in stiff bunches. For the sake of these exudations the ants do not merely tolerate the existence of symphilous insects, but even look after them, and in time of danger rescue them with the brood. As the exudations are brought forth only in very small quantities they are not a necessity but a luxury ; the craving for them may amount to a social evil in an ant state, and for this reason Escherich compares it with the passion for alcohol and opium among men ; it sometimes costs the ant state not only a part of its nourishment, but also its brood. Symphilous instincts among ants must be regarded as differentiations of the general brood-tending and adopting instincts.

Wasmann takes the relation between the beetle *Lomechusa strumosa*, and the ant *Formica sanguinea*, as a classic example of symphilia. The ants feed the beetles from their crops and tend their young with greater zeal than they do their own brood, even though the *Lomechusa* larvæ devour the eggs and larvæ of the ants in large quantities. This aberration of the normal brood-tending instinct results eventually in the production of a stunted type of ant intermediate between a worker and a female, the pseudogynæ. In this way the ant colony eventually perishes from degeneration, and the *Lomechusa* migrate to another nest. Some of these parasites, e.g. the beetles *Lomechusa* and *Clavigera*, adapt themselves so completely to the habits of their hosts that they make use of their antennæ to tap the ants with

which they come into contact just as these do each other.

As I have already said, ants belonging to different nests, even when members of the same species, are hostile to one another ; they rob one another of aphides and stores and brood, and go so far as to drive one another out of their nests. Before an organized foray, scouts spy out a favourable moment for the attack. Inhabitants of the same nest recognize one another by the special nest odour, which, as among bees, is a compound of that of the individual and that of the nest. Sentinels stand at the entrance of the ant-hill and drive away all who do not bear the " uniform " of the special nest odour. Ants which have been kept isolated from their nest comrades are welcomed by the latter months or years later. Where this does not happen it is to be supposed that the returned wanderer has lost the nest odour in the interval. In a mixed colony there is a special mixed smell, and on this account masters and slaves of different species live peacefully together in the same state, provided they all possess an identical " livery of smell " ; they will make common cause against the inmates of another state, even though they belong to different species.

It is possible to create artificially mixed colonies by placing together young ants, only just out of the cocoon, in an artificial nest, for they do not then possess any special nest odour ; either they have not as yet acquired it, or it may not yet have been formed. Mixed colonies of older ants can be created by thoroughly shaking representatives of different species together in a sack, whereby the different nest odours blend with one another ; but it is true that this experiment

does not succeed with all species. It has never been found possible to create mixed colonies of ants and termites.

Ants do not always allow their behaviour towards other ants to be guided blindly by the nest odour. If a few individuals of different species are put together into an enclosed space their desire for companionship often conquers their mutual hostility. Should a female, incapable of founding a colony by herself, enter the nest of another species which has lost its queen, she is not put to death, but adopted. Peace may be spontaneously concluded between two nests which have carried on a long and indecisive war, or between two nests simultaneously menaced by a common enemy. In such a contingency the hitherto hostile tribe is recognized by its smell and duly respected. The means of mutual understanding which ants possess in the shape of their "antennæ language" will be dealt with in a special section of my General Animal Sociology.

4 Termites

Termites (Escherich, Doflein, Deegener) provide an interesting parallel to ants, and for this reason they have been called "white ants", although the two species have strictly no connexion with one another. Some of the resemblances between them are very striking, and provide us with what is, perhaps, our most impressive instance of convergent evolution between two animal groups, the similarity of whose habits has produced similar morphological and biological characteristics. Unfortunately we are still very ignorant of the psychology of termites, which is especially regrettable for present purposes.

A single termite state may contain only a few hundreds of inhabitants, but in the case of tropical species these may number millions or even milliards. In addition to winged males and females there are sterile and wingless workers and soldiers which are specially modified males and females, divided, sometimes, into sub-castes. The workers are able to produce recruits for all the various castes from the sexless young ; and they are even capable of rearing substitute males and females from worker and soldier larvæ, and soldiers from male and female larvæ, probably by varying the nourishment with which they supply them. The workers are careful to maintain the proper numerical proportion between the number of individuals in each caste ; if there are too many in any one caste the superfluous insects are killed and eaten ; if there are too few the scarcity is relieved by the transmutation already described.

The functions of the workers are nest-building, gathering food, cleaning and feeding the males, females and soldiers, tending the brood and keeping the hive clean. The larger workers busy themselves outside, and the small workers inside, the nest ; the latter is defended by the soldiers, which are incapable of feeding themselves. The soldiers are subdivided into classes according to size ; the outer defences are manned by the larger types, whereas the medium-sized and smaller ones police the interior of the nest ; these latter supervise the groups of workers, urging on idlers with taps of their antennæ. Under the supervision of the smaller soldiers, workers take in charge the eggs laid by the queen ; larger soldiers surround the king and queen, and defend them if necessary. The sentinels posted at the entrance

give the alarm when danger approaches by tapping and chirping.

After swarming both male and female shed their wings, remain together as a pair, and often only attain sexual maturity after a period which may extend from a fortnight to five months. The pair hide themselves and dig themselves in together. When the first eggs hatch out, brooding instincts appear in both males and females ; later the adult workers assume responsibility for the offspring. From one to six pairs have been found in the same nest. In many species the queen lays an egg every two seconds, and may continue doing so for years. Every pair copulates repeatedly, and lives monogamously unless one of the partners dies. If the queen perishes the king is provided with a number of substitute queens (as many as a hundred) and lives henceforward polygynously. If both king and queen die, numerous substitute pairs arise in their stead.

In cases of necessity, i.e. when the king or the queen, or both, die, substitute males and females are generally reared from a special type of larvæ held in reserve. Worker or soldier larvæ are seldom converted into substitute males or females. Sometimes a winged male or female couple is prevented from leaving the nest to swarm and is put by force in the place of a pair which have died. In some species a " substitute " type exists side by side with the normal males and females, whereas in other species no such type is ever found. Soldiers also, on occasion, lay eggs.

Colonies are sometimes founded by a secession from the mother nest ; in this case a number of workers, taking with them eggs and larvæ, form a new nest, which is at first

closely connected with the old one, but later becomes totally independent. A new royal couple is created for the new nest from substitute males and females; sometimes a young pair is adopted from outside.

Termite workers devour their sickly and dead companions. They feed the larvæ, the males and females, the soldiers, and their fellow workers by regurgitation or, in the case of wood-eating species, by defecation. In these species the excrement always contains a considerable amount of nutriment. One ant "begs" excrement of another by stroking the hinder part of its companion's body with antennæ and feelers. The flow of excrement may be produced experimentally with the help of a paint brush. Excrement and vomit are also used in nest-building.

Termites, like ants, construct store-chambers. With termites these contain fragments of finely shredded grass and leaves or grain and other seeds. Termites also cultivate fungi; the soil they use is vegetable matter reduced to very small pieces. These fungus gardens must be diligently weeded, for if they are removed from the care of the termites they run wild in a very short time. It would appear that, besides weeding, some complicated process of cultivation is needed; for the small knots which appear on the fungi and are used as food for the queen and the young brood, grow only under the care of the termites.

Individual termites belonging to the same nest also know one another by a special nest odour; strangers which do not possess this smell are killed. Ants and termites are one another's greatest enemies, ants always being the aggressors. Termitophila are found associated with termites. As among

ants, three different species can be distinguished : (1) the synecthrans, (2) the synoekites, and (3) the symphiles. The last exude secretions. The growth of special hairs is more or less absent among the real guests of the termites ; exudation takes place through pores in the skin, but here, too, in such small quantities as only to provide a luxury, not a necessity. The termites nourish the symphiles on royal food, tend them, lick them, and sometimes rear them. These are harmful chiefly because they often attack the termite brood. Symphiles are nearly always beetles of one kind or another, but may also be flies, or a species of butterfly. Among termites as among ants, certain insects are used as " milch cows " ; the termites visit these insects outside the nest, or keep them inside it for the sake of their excreta.

VII GENERAL ANIMAL SOCIOLOGY

In this section I shall give an account of the general features which characterize the social life of animals. This science is still, unfortunately, in its infancy, and consequently what we have here to offer cannot be compared with the very substantial achievements of human sociology. Yet we can even now state various facts of very great interest from the point of view of comparative group psychology.

A THE SOCIETY OR THE COMMUNITY

A distinction has been drawn above between associations and societies ; the first are chance aggregations in the sense that they are brought together by external environmental factors (light, warmth, nourishment, etc.), whereas societies hold together because all their members possess special social instincts. Societies may be classified as (1) closed or (2) open communities. In the first case it is only under special conditions that new members are admitted, or that a member, once incorporated, withdraws ; furthermore a well-defined hierarchy is very often found to exist. In an open society, on the contrary, the members come and go without any special difficulties ; it is therefore possible to distinguish between (*a*) organized and (*b*) unorganized communities ; in the first the individuals have each their appointed status, in the second there is no such arrangement. Considering the difficulty of making clear-cut lines of

demarcation in the natural world, this division is, I think, not excessively artificial.

The community is held together, and its members are able to recognize one another chiefly by means of either the sense of smell (insects, many gregarious mammals) or the sense of sight (especially among birds). The sense of hearing often forms a useful auxiliary, and the more or less perfect development of the sense is coincident, among many social animals, with the possession of characteristic vocal organs. The horse whinnies if separated from his stable companion, and thus gives expression to the frustration of his social instincts ; a dog unaccustomed to loneliness, howls ; birds sound notes of invitation or warning as occasion requires ; a goat, alone in a stable, moans, but give it a rabbit for company and it is soothed at once. The goat and the rabbit do not enter into any closer relation ; the fact that another living creature is present is sufficient to allay the goat's desire for companionship. In Java macaques are often kept in stables ; the Javanese say that this prevents the horses from becoming bored, and makes them thrive better.

Whether or not individuals of the same species recognize one another as members of the same community in many cases does not seem to depend upon their colouring ; otherwise it would be impossible for albinos to appear, as they occasionally do, in flocks of birds (among sparrows, cranes, etc.). Moreover, under natural conditions, the males of the species *Machetes pugnax* are quite differently coloured and yet associate freely with one another. Domesticated fowls, ducks and pigeons recognize their comrades in spite of differences of colouring, and this is also true of domesticated

dogs. The homogeneity of a species, in spite of the varied appearance of its members to human vision, is conditioned by their whole demeanour, and among dogs, also by a similarity of odour. I have to thank Dr. Drost, of Heligoland, for the following communications bearing upon this point. During marking experiments carried out upon migratory birds taken from the bird sanctuary there, a number of the birds are painted different colours in order to make them specially recognizable. These birds are always admitted by others of the same species to the communities to which they belong (e.g. peewits painted red). The same holds good for domesticated fowls which had been painted in order to carry out preliminary experiments. Thus if birds cease to be recognized by their own kind it must be for other reasons than that of a mere difference in colouring (for further details see below).

1 Closed Societies

The closed society is a community shut against non-members. These are either totally excluded, or gain admittance only with great difficulty. Within such a community there is often an established hierarchy; among birds it is likely that this is always the case, but it probably never occurs among insects.

Insect states are closed societies. As we saw in the section which dealt with them, inmates of the same nest or hive recognize one another by a separate and distinct nest odour, even when the state to which they belong contains millions of inhabitants, for inmates of the same nest bear the same "uniform of smell". Mutual tolerance, therefore, does not

depend upon recognition of one another by the individuals concerned. Membership of the same community, and not membership of the same species, decides whether two animals shall tolerate or shall fight each other ; this is particularly clear in the mixed colonies of ants, where different species may be citizens of one and the same state, and hold together through thick and thin.

Single bees, isolated from the hive, soon die. They live longer if they have access to the odour of the hive and to that of the queen in particular. It is quite unnecessary that they should be near the hive and the queen, the odour has merely to attach to their prison. Solitary bees, on the contrary, bear isolation without any ill-effect.

According to Goetsch, mere solitude does not shorten the life of ants if they are given earth and brood with which to satisfy their building and brood-tending instincts. If either of these instincts remains unappeased they die. They perish more quickly when both building material and brood are lacking. Ants will remain alive under the most unfavourable conditions if, in addition to building materials, they are given a queen and brood. Where a queen and brood are lacking the cause of death is perhaps the want of those substances which the ants lick from their bodies rather than the impossibility of satisfying their tending instincts. If a new queen is placed in a nest which has been long without one, the workers cannot lick her enough.

Solitary monogamous mateships and families, and solitary harems are closed societies. In these the parents always know their own young ; some parents, e.g. ostriches, bite and kill young which do not belong to them. Hordes which

inhabit a special area and defend it against intruders are closed societies. We may include here those animal communities whose members have been thrown together by chance within the same cage, and have there formed an organized society. Mutual recognition and tolerance in all such cases is the result of the individuals knowing each other.

The half-wild pariah dogs of the East, according to Brehm, immediately attack any of their kind which have not grown up with them, and which, so to speak, have not scuffled together with them. Thus in oriental cities every street and alley has its own pack of half-wild dogs, which never leave it. If one of these dogs enters a strange alley, the dogs domiciled there fall upon the stranger and tear it to pieces unless it saves itself by speedy flight. Penguins behave in just the same way during their breeding time. They brood, as earlier described, in gigantic colonies which are traversed by numerous pathways cutting each other at right-angles. Each of the resulting rectangles is the home of a pair of penguins. The birds in the neighbouring rectangles are manifestly more closely connected with one another than with the rest of the birds in the brooding colony; but if a penguin strays into a more distant block of nests where it has no right of abode, it is fiercely expelled.

A society often has a leader. We saw that among mammals this may be either a male or a female, according to the species. Often the strongest and most experienced animal holds this rank. But from certain observations made by Schjelderup-Ebbe on fowls, to be discussed later, we may infer that strength and experience are not the only

qualification necessary, but that in addition a specific aptitude for leadership is involved. Among fowls, physical strength alone does not determine the status of an individual in the "pecking order"; psychic factors are more important. In those hordes of apes which are composed of several harems, each with its own pacha, the latter rules only his own family. Each harem is more closely united within itself than with the remaining harems, and yet the old males together watch over and fight for the safety of the whole horde. Among Arabian baboons, when a horde is on the march, a few old males lead the way, others remain in the rear, while others again are posted as sentinels at elevated spots. In case of danger every full-grown male makes for the threatened point. When the horde takes to flight the old apes deal out cuffs and blows to the younger and less experienced, forcing them thereby to hasten their movements (Schillings). Wounded and dead companions are borne along with the horde, and this does not apply only to mothers and their young. According to Brehm, an old male Arabian baboon which had been wounded supported himself right and left upon young apes, and boxed their ears whenever any detail of the flight was not carried out according to his wishes.

If an animal seeks admittance to an already established closed society it is, as a rule, initially received with great hostility. Schulz added a third to two young rhinoceroses who were used to one another; these two immediately attacked the new arrival and harmony and friendship were not established until later. The same thing happens if a new animal is placed in the common cage of a zoological garden.

Apes and beasts of prey, also prairie marmots, parrots, etc., hurl themselves immediately upon any new-comer of their own species or breed, and ill-treat it or bite it to death. If the stranger survives this reception, peace is often established only after a great deal of scuffling ; possibly such battles are always waged with a view to establishing degrees of superiority (see below Schjelderup-Ebbe on hens and ducks) ; according to Pfungst every ape " knows its place " within the herd.

According to Köhler, a chimpanzee kept in solitary confinement is no true chimpanzee and becomes such only as a member of a group. The same is true, in greater or lesser degree, of all social animals, and of men. The actions of other members of its own species are, for every individual, the sole stimuli capable of prompting a large number of vital activities ; group solidarity is a real force of the greatest importance.

The chimpanzees kept in the experimental station at Teneriffe when first procured were quite young ; they might be called children (Rothmann and Teuber, Köhler). In the early days of their captivity they tended to form a herd, but this tendency disappeared as they became more familiar with one another, and an elder male took the lead. Once they had trodden out paths on their allotted patch of grass, they stuck to them. It was noteworthy that each of the animals possessed a strongly marked individuality. The group, therefore, was in no sense homogeneous ; rather each animal went its own way. Friendships grew up within the community and changed from time to time ; but alliances were formed when, for example, they had to punish one or

other of the animals. Friends shared their stores of food, handing portions of it to each other. They all united immediately to attack a new-comer. The chimpanzees very seldom clasped hands in greeting one another, but often did so in order to express their sense of good fellowship in particularly enjoyable situations. In more effusive greetings, gestures were made distinctly suggestive of sexual emotion. A favourite form of greeting was to stretch out the arm with the paw curved inwards ; this gesture was used as a sign of welcome, and was extended to friendly human beings to whom they were attached, and to other apes ; it was also used in the recognition of their own photographs. Chimpanzees regard a friendly human being as belonging to their group.

If a chimpanzee was isolated for experimental purposes it behaved as though it had gone out of its senses ; the remainder of the group showed much less excitement over the loss of their companion. The same sort of thing happened when after the lapse of a few weeks the imprisoned chimpanzee returned from its isolation. This differed, however, with the ape concerned. If it was the oldest animal, which invariably held a special position in the community, the rejoicings were always greater than in the case of one of the younger apes.

One or other of the chimpanzees was sometimes shut up in a cage by itself ; although it always howled and moaned, its companions did not come immediately to the cage and embrace it : thereupon it would stretch imploring arms towards them, and if they still did not come it would push its blanket, straw, or any other movable object in the cage,

between the bars and brandish it in the air, but always in the direction of the other chimpanzees, finally throwing the objects, one after another, towards them.

Playthings, such as jam tins, pieces of wood, stones, rags, etc., were often carried about wedged between the lower part of the stomach and the upper part of the thigh. By way of greeting they sometimes put their hands in each other's laps, or one would take the hand of the other and draw it into its own lap. The animals were inclined to use this form of greeting without hesitation in their intercourse with men, thus recognizing them as friends and beings of a nature resembling their own. Köhler denies that this ceremony has a sexual origin; believing rather that the apes press the hand of a friend into the place where they are accustomed to hide their treasures. Whether the action is purely instinctive (i.e. whether it is carried out by chimpanzees in their natural state), or whether it was invented by one of the captive animals and imitated by the others is not known.

If a chimpanzee climbs up its keeper in order to reach some object, and the keeper then bends down so that the attempt does not succeed, it will try to induce the keeper to straighten himself. If the animals need water they will drag the keeper with all the force at their disposal to the door behind which the water butt is usually kept. If some object is out of reach they will persuade a man to approach them and then take his hand and move it in the required direction. In consequence of the close morphological similarity between apes and men, apes find it easy to understand the nature of the human body.

The chimpanzees were capable of taking each other's part, or the part of their keepers, against other men or other chimpanzees. After quarrelling they always showed a strong desire for reconciliation. Jealousy was an emotion by no means unknown among them. An animal would plead not only for itself but for another, before punishment. According to von Oertzen, a young gorilla will also, before being punished, try to cajole its keeper. Chimpanzees embrace one another and also human beings as a sign of affection, or when they are frightened ; and these embraces are accompanied by a stroking of the back.

According to Köhler chimpanzees communicate with one another by means of noises and gestures, but neither noise nor gesture could be interpreted as the designation of an object.

Many of their gestures and sounds could be understood by human beings without difficulty, but some remained obscure. On the other hand the chimpanzees always understood each other immediately. Laughing and weeping is unknown among them, and they are always at a loss when confronted with human laughter.

The behaviour of a mother and child in captivity during the first three months of a young chimpanzee's life has been described by von Allesch. At first the other chimpanzees took a deep interest in the newly born infant, but afterwards their interest faded. The mother, as far as she could, avoided all excitement, and tried, for instance, to soothe another chimpanzee when it made a noise by patting it softly and caressingly.

The members of a society may be extremely attached to

one another. This, for example, is said to be specially characteristic of bullfinches. If one of a flock of these birds, collected together between two breeding seasons, is shot, the others remain near it for a long time, uttering cries of sorrow. This occurs more especially when the flock is small, that is to say when the birds stand in an unusually close relation to one another. If two domesticated hens fall to fighting, the cock not infrequently separates them ; one cock may also intervene between two others which are fighting, but never does so unless it is superior to both the combatants.

It is not always possible to draw the line sharply between closed and open societies. A brooding colony of penguins may certainly be classified, in general, as an open society, if only in virtue of the number of its members, and yet, as we have seen, each group of nests is a closed society. In other cases our knowledge is still so incomplete that we do not know in which category to place our instances. The mammals mentioned below, which live in colonies, are, therefore, included in this section only under reservations.

Members of the genus of marmots lay out subterranean dwelling places, and inhabit them in large numbers between one breeding season and another ; when these animals come to the surface of the ground they post sentinels.

Among vizcacha the subterranean dwelling of one animal will be connected by passages with those of several others. Settlements of this kind are called vizcachera. Within them there seems to be always one old male which assumes the rôle of leader. Neighbouring settlements are linked by well-trodden paths used by the animals for visiting one another.

If a vizcachera is destroyed, the inmates are rescued by the inhabitants of the neighbouring colonies.

In Germany beavers are now usually found living in pairs ; only in the most retired localities do they still form colonies, whether large or small. In more populous regions they usually house themselves in simple subterranean burrows, and do not build a fort. These forts, when they do occur, are oven-shaped, thick-walled mounds, made of peeled sticks and branches, earth, clay and sand, and they contain an inner living room, and a chamber used for storing food. In places where the animals are left undisturbed a large number will toil together at building a fort. The females are the real architects and builders, while the males collect and furnish the necessary materials. If the water changes its level in the course of the year, or is not of sufficient depth, the beavers build a dam across the stream and stem its flow. The dams are built of the same material as that used for the fort, and have an almost vertical wall on the water front, but on the other side merely an escarpment. Any breaches in the dam are sought out and repaired. Canadian beavers sometimes support an original dam with others built out from the base of the first. The dams of European and Canadian beavers are said to be hundreds of years old, and if this is true then countless generations must have laboured on them and toiled for their preservation.

Animals belonging to species which, under natural conditions, have no intercourse with one another, will make friends in captivity, driven thereto by the lack of any other outlet for their gregarious impulses. An ape may become genuinely attached to a sheep, a pig, a rabbit, a parrot, or

a bird of prey ; and captive animals very often quickly develop an affection for their keepers. Schillings was able to increase the happiness of a young, newly caught rhinoceros very considerably by giving it the companionship of a full-grown female goat. Friendly relations were established between the animals in the course of a very few days, although neither of them derived any material profit from the presence of the other ; the goat did not, for instance, suckle the young rhinoceros. The friendship became, indeed, so close, that the goat often disposed itself for sleep leaning against the rhinoceros. Tame baboons, like some dogs, are devoted only to their masters, greeting them joyfully, but showing themselves invariably hostile and ill-tempered towards strangers. A caged marabout would greet Schillings by flapping its wings and nodding its head, and would not rest content until its master had caressed it. Although this marabout would have nothing to do with any other animal in Schillings' camp, it was on terms of close friendship with a young rhinoceros.

Brehm, from his own experience of chimpanzees, judges that in their intercourse with men they subordinate themselves to higher talents and powers, whereas they regard other animals with the same consciousness of superiority as that with which men regard them. Chimpanzees always behave with great gentleness towards children, having a special affection for the smallest. Brehm believes that this indicates that the anthropoid apes recognize man, the superior, even in the smallest child. They comport themselves with much less consideration towards their own kind, more especially when they are younger than themselves.

In the common ape cage in the Berlin aquarium a young gorilla treats only a young chimpanzee as its equal, choosing it alone as a companion to play with and caress, and behaving with a complete lack of consideration towards the other non-anthropoid apes.

Brehm describes a friendship between two full-grown apes, a long-tailed monkey and a baboon. The long-tailed monkey was completely dominated by the very much larger baboon, it would not venture abroad nor take food except in the company of the latter. If the monkey did not voluntarily share his food with the baboon the latter would use force, sometimes even extracting morsels from the cheek pouches of the other, and it was very seldom seen to reverse the procedure by giving something to the monkey. According to the same author, a small ape, kept captive on a ship, when it was to be punished would take refuge on the breast of an orang utan, and the orang utan would then climb with it into the rigging, against its usual habit, and remain there until the danger was past.

Schillings relates how, in a fort in East Africa, a friendship grew up between an old captive male baboon and a small native child about a year and a half old. Each day, from its hut near by, the child would crawl to the ape and play with it for several hours.

Caged parrots may form intimate friendships with one another, even when they belong to different species. If a male and a female are shut up together amorous relations often develop between them and the birds will bill together hour after hour ; it sometimes happens, in fact, that if one of them dies the other does not long survive. According to

Brehm, a captive purple water-hen (*Porphyrio*) assumed the attitude of the sexual act both in the presence of its keeper and of a lory. The lory frequently attempted coition, and attacked the keeper, screeching if he stroked the purple water-hen.

It may here be mentioned that, under natural conditions, the weaver-bird (*Dinemellia dinemelli*) lives in intimate relation on the one hand with *Spreo superbus*, and on the other with the great grey shrike (Schillings). These birds play together in the air, chase each other as butterflies do, perch close to one another, etc.

2 The Open Society

The characteristic feature of an open society is that, as compared with a closed society, it is much less exclusive. Chance alone determines whether its members shall come together or separate; but when they do unite social ties of various kinds are formed immediately; in particular, the animals concerned act with conspicuous uniformity (e.g. in flight, foraging, resting, etc.). If, in such open societies, any hierarchy is established, if watches are set during the resting periods, and leaders come forward, the community becomes (a) an organized open society; if, however, the community is homogeneous in the sense that apart from chance differences of size and strength no one member is superior to another, then it is (b) an unorganized open society.

a The Organized Open Society

The herds and bands of mammals which gather together between two pairing seasons are often open, and yet

organized, societies. One animal acts as leader, and it is common for watches to be set while the herd rests. Herds of gnus and buffaloes often rest on hills dominating the surrounding country (von Oertzen). Herds of giraffes are led either by a male or a female, and this also is true of herds of cow antelopes. In the latter sentinels often take up their stand upon anthills.

According to Pallas (quoted by Brehm) the saiga antelope lives in large herds; the old males remain with the herd throughout the year. Single animals are always on guard, and no sentinel ever betakes itself to rest without calling upon another animal, by nodding to it and advancing towards it in a peculiar manner, to relieve it. Only when another animal has risen to its feet and taken over the watch does the first one lie down. These antelopes, when danger threatens, first herd together, and then take flight in a long line led generally by a male, but sometimes by a female.

In other species the leader is either always a male or always a female. Among wild reindeer, it is the leader, a female, which invariably acts as sentry and remains standing even when all the other members of the herd are resting; if it signifies its intention to lie down, another female immediately rises to its feet. If danger is near the leader may induce the rest of the herd to rise to their feet by prodding the animals with its horns. In certain circumstances, as is well known, a herd of animals will follow its leader blindly, even when the latter precipitates itself into an abyss. If the leader is killed the herd may lose its head completely. Herds of Caing whales are also led by old males, whom they are said to follow blindly. Brehm relates that one of these

whales, which escaped when the rest of its herd was massacred by coast-dwellers, returned again and again to its dead and dying companions.

In a herd of cattle the leading cow possesses the largest bell. The cattle recognize exactly the tinklings made by the bells of their own herd, and usually find their way back to the herd again after straying. The leader displays a certain feeling of rank, and will not allow another animal to precede it. In South America large herds of llamas are used as beasts of burden and the leader is a male richly decked with blankets. Similarly the leader of a South American caravan of mules is always sumptuously adorned. Among sheep, a leader furnished with a bell keeps a flock of three to four thousand head together. If the bell ceases to sound the flock breaks up into groups of six to twelve sheep, each with its own leader. The action of man in making one selected animal recognizable at long range, enables it to act as leader to several thousands of its own kind. I have myself observed among the goats living at the edge of the Zillertal forest, that the leader provided with the bell does not, in every case, guide the herd, and that consequently the remaining animals sometimes do not imitate its movements. The leader is often to be found in the centre of the herd ; the animals which happen to be in the front ranks determine in which direction the herd shall move, and the leader is, so to speak carried along with the stream. In such cases, the leader forms rather a rallying point, from which none of the animals stray very far.

Schjelderup-Ebbe has shown how an order of precedence comes into existence within societies. A flock of fowls in a

fowl run is not exclusive in the sense that its members make common cause against a new arrival, leaving the latter isolated. The new-comer may safely attach itself to the flock, but the position it is to hold therein must first be won by fighting. For no two hens ever live side by side in a flock without having previously settled, either for the time being, or for good, which is the superior and which the inferior ; the " pecking order " thus established decides which of the birds may peck the other without fear of being pecked in return. Similar pecking codes exist, according to Schjelderup-Ebbe, among sparrows, wild ducks, and possibly among many other kinds of animals. Pecking among cocks is governed by the same rules as among hens, except that the cocks exhibit greater ferocity. Such " pecking orders " give the society concerned a certain degree of organization.

Sometimes the " pecking order " results in a continuous list being formed ; that is to say, one hen pecks all the others, the next in order pecks all but the first, and so on, down to the humblest member of the community which is pecked by all the rest of the flock. But it may happen that three hens peck one another, so to speak, in triangular order, i.e. A pecks B, B pecks C, but C pecks A ; or the order may be a quadrilateral sequence of the kind $A \rightarrow B \rightarrow C \rightarrow D \rightarrow A$. This is enough to prove that strength alone is not the deciding factor. A hen low on the list is usually much more cruel to the remaining hens which it may peck than a hen which occupies a higher rank. The hen which is entitled to peck all the others is generally the least malicious. A threatening note usually precedes the pecking and is often sufficient by itself to put the offender to flight.

Which of two hens is to be the inferior and which the superior is settled, as a rule, at the first encounter ; one of the hens may yield without a struggle, or the issue may have to be fought out. The triangular and quadrilateral arrangements which occur within the " pecking order " are explained by the fact that the hens sometimes submit without fighting. Not infrequently the stronger hens allow themselves to be pecked by the weaker. The reason is that the younger hens are usually attacked by the older, the new-comers by the established residents, and the sick by the healthy, and the order, once established, is permanent. If several weak hens simultaneously attack a stronger one and defeat it, the latter is afterwards pecked by each of the former. Katz and Toll tested the intelligence of different fowls, and have established that the fowl which stands at the head of the list is also the most intelligent, and that, roughly, the position within the social scale corresponds to ascertained differences of intelligence.

The tendency to form a social organization is innate in quite young chickens, whether or not they have been brought up with older fowls ; it follows that the tendency must be purely instinctive and in no way dependent upon tradition. I think one can go even further and say that the instinct is, in a measure, indispensable to the very existence of social life among such animals (which, unlike the state-building insects, live mainly for themselves, and not for the welfare of the " state"). If this instinct failed immediately to establish a recognized order, such animals would pass their lives in a state of constant warfare, since their social instincts prompt them to seek one another's company, while their self-

assertive instincts urge them continually to attack one another. The "pecking order" is of great importance to the hens, for the superior bird is not disturbed when on the nest, nor robbed of its food, whereas it may disturb others and infringe their rights with impunity. The battles between hens or cocks are, therefore, not mere sport. A cock wields, in every case, despotic sway over all the hens, and will often interfere between two fighting hens, or even between two cocks which are attacking one another (provided, in this case, he is the superior of both the combatants). With penguins the case is different; for if the males fall to fighting, the females sometimes throw themselves between the antagonists and separate them.

The position of a hen on the "pecking list" is occasionally altered as the result of a fight; in such cases it is an oppressed hen which revolts against her oppressor. Such a rebellion occurs less frequently when the position was initially decided by fighting than when it was tacitly accepted. A battle of this kind either confirms the previous state of affairs or reverses it. A hen revolting against the hitherto recognized superior fights less fiercely than at other times; this proves the existence of a psychic obstacle to such an attack.

Once a hen has fallen into an inferior position, it is more difficult for it to mutiny and thereby gain superiority, than if it had fought for its place from the outset.

During breeding time a hen shows itself much more easily irritated by other hens, and not infrequently revolts against its superiors. A hen with chickens is full of courage; but if the chickens are taken away, even for a short time, this

courage vanishes and the hen allows itself to be attacked and overcome by any aggressor (compare here the case of the male stickleback robbed of its nest).

If two flocks of fowls are penned together, flock does not fight flock, but as time goes on a series of single combats take place. Behaviour of this kind must be regarded as characteristic of an open, and at the same time organized, society.

A recognized order of precedence also exists in a flock of wild ducks. Within any such flock, inhabiting some particular pond, it is agreed, both among the males and among the females, which is to be superior, which inferior. For every one of the birds recognizes every other with unflinching certainty (as is probably always the case among birds and mammals). Any male is superior to every female. The battles fought for social superiority are never as fierce among wild ducks as among domestic fowls. The winner is thenceforward entitled to bite, whereas the former must always submit to being bitten.

Some bird societies show a more advanced type of organization in that they set guards and send out scouts. Thus flocks of cranes (which may be composed of different species), in their winter quarters, are guarded while at rest by sentinels. If a flock has been disturbed in any given place, before it returns to the neighbourhood again scouts are sent ahead to spy out the land. Flamingoes set guards at night; if these are killed noiselessly it is possible to kill many of the remaining flamingoes while they are still asleep. Flocks of geese and flocks of parrots safeguard themselves while resting by posting sentinels. Crows also

set guards while the flock is feeding. Cockatoos out on a marauding expedition send scouts ahead of the main flock. A certain stage or organization can be inferred from the fact that during migration the separate species always observe a special flight formation.

Leaders, too, occur among birds; thus, among the *Penelope* species the birds gather between two breeding seasons in flocks containing from sixty to eighty head, under the leadership of an old male. In a flock made up of different species the largest bird is often the leader; for example, sometimes in the winter a gathering of titmice, nut-hatches, and creepers will be led by a great-spotted woodpecker.

A flock of sleeping partridges provides an instance of the organization of a whole society, for they pass the night in a circle with their heads turned outwards; a herd of wild swine on the contrary so arrange themselves for sleeping that every head is turned towards the centre of the ring.

The members of some species of animals join together to form more or less organized hunting packs. Wolves live during the winter in packs; a pack of this kind travels in single file, one animal treading in the footsteps made by another in the snow. The animals hunt in common, and the pack divides into two bodies, one of which pursues the prey while the other bars its path. The African hyæna (*Lycaon*) hunts in packs for large game. The animals in the rear follow the chord of the arcs described by the animals in front, relieve these latter at the point of intersection, and take the lead themselves; this manœuvre being

repeated until the prey is exhausted. Lions hunt together where the country is rich in game, at times accompanied by their young ; some act as beaters, others capture the prey ; while on the hunt, their roars appear to have some important significance. According to von Oertzen three tame young leopards combined to hunt fowls ; one drove the birds while the other two ambushed them. I have already mentioned the case of the dogs rendered masterless by the Russian invasion of East Prussia in 1915, which, in their distress formed packs of about a dozen and hunted in open formation across the fields.

A pair of birds of prey will often hunt together, each mate helping the other. Marabout (*Leptoptilos*) hunt in flocks on the grassy plains of South Africa for the numerous grasshoppers to be found there, allying themselves often with storks in this pursuit. The birds spread themselves into a far-flung line, and move in this formation over the open ground, thus beating a wide area. Gannets fly side by side in a long string in their pursuit of flying fishes. Screamers fly over water together in large flocks, and from time to time a number of the birds dive down to fish. Pelicans fish together in shallow waters. They form a circle, and then narrow it slowly by swimming towards one another, or they make a semi-circle and advance towards the shore. In rivers they form two lines which advance towards each other. Cormorants are said to fish together sometimes systematically, in a sheet of water or over a particular stretch of the sea, in just the same way as pelicans. But among the birds I have named (marabouts, storks, gannets, screamers, pelicans, cormorants) mutual assistance (i.e. if

one calls by this name their hunting in common) is never carried to the point of mutual defence.

b The Unorganized Open Society

The migrating societies formed by many, strictly speaking, non-social insects, which at certain times collect in swarms and travel together over the ground or through the air, are unorganized societies (grass-hoppers, dragon-flies, butterflies, caterpillars, etc.). The permanent associations formed by certain kinds of caterpillars must likewise be named unorganized societies.

I had occasion to observe in the aquarium of the Biological Institute in Heligoland how a swarm of animals may act uniformly, even though it is moving forward without a leader. Large and small *Ammodytes* live there in mixed swarms ; these two species rarely swim along with mackerel, but when this happens, the mackerel, as the larger fish, always lead the way. Assuming that a swarm of *Ammodytes* are swimming in a straight line across the tank and one of the fishes suddenly makes a turn, its example is immediately followed by another. According to whether most, or, ultimately all the others follow the lead thus given, the swarm as a whole swerves aside from the initial direction ; or else those fishes which had swerved aside reverse their movements and return to the main swarm as it proceeds on its way. It is certain that these animals keep together chiefly by the help of sight ; for when a swarm completely reverses its direction, one fish will turn to the left and another to the right, which would not occur if they were guided by a sense of taste or vibrations set up in the water. If one of the

swarm falls behind or deviates, temporarily, from the path of its companions, it forthwith tries to regain the swarm by accelerating its movements, and the necessary turns are so promptly and surely carried out that they must be guided by sight alone. Even when *Ammodytes* and mackerel are swimming apart, the former may readily leave their original course to follow the latter. On the other hand, solitary fishes remain totally unaffected by alterations in the movements of other fishes.

Among the highest species of molluscs, some, like the Cephalopods (cuttlefish), live a genuinely gregarious life; swarms of them may migrate over great distances. In the aquarium one can observe how the whole mass, like a real swarm of fishes, changes its direction simultaneously. Likewise, certain reptiles live in societies (lizards, geckos, agamas, chameleons, etc.), which do not, however, seem to possess any social grading or any real organization.

Some fishes, among them salmon and herrings, are reported to travel in V or wedge formation. In the case of the latter the larger and stronger fish are said to form the van, which would seem to indicate the existence of a certain rudimentary type of organization. Shoals of herrings are, likewise, divided according to the generations to which the fishes belong. If a shoal is scattered, as a rule it speedily reunites. Whether or not the shoals keep together during the night is disputed. In some species the bond uniting individuals is so close that when one fish discovers a way of escape from the net all the others follow instantly.

It has been observed among sticklebacks and other species that some one individual, whether male or female,

is specially feared by its companions, which it constantly attacks and drives away, particularly when feeding. If it turns out that in swarms of this kind superiority is accorded to greater biting powers, such swarms should not come under the present heading, but should rank as organized societies.

At breeding time, as I have described, the male sticklebacks desert the swarm, and each one takes possession of a special domain which it defends against intruders. By way of experiment a large fish which preys upon sticklebacks was placed in a tank containing a number of males of the latter species. These, which had hitherto kept to themselves, each in its own domain, immediately united again with each other, and with the females, into a swarm ; so that in face of a superior enemy their gregarious instincts reasserted themselves. The same behaviour is reported (Brehm) of the American oriole. Each pair defends its particular domain against its neighbours, but a cry of fear will bring the latter out instantly to do battle with the common enemy.

VIII GENERAL ANIMAL SOCIOLOGY (*continued*)

B MUTUAL HELP AND MUTUAL HARM

Mutual help in the animal kingdom, and its contrary, mutual harm, form a much disputed section of animal sociology (see particularly Kropotkin). Cases of mutual assistance occur frequently ; it would be folly to deny them. But it is unwise to generalize too freely from these occurrences, or to regard them from a sentimental point of view. For it is also a fact that mutual harm plays a large part in the animal world, not only between members of the same species, but even between members of the same society.

The most obvious type of mutual help consists in one animal, though not itself attacked, hurrying to intervene on behalf of another on hearing a cry, either of warning, or of fear. Schultz relates that when one of his young rhinoceroses was attacked it, in turn, immediately assumed the offensive, while the other hurried forward to take part in the fray. Among Köhler's chimpanzees, if one was exposed to a real or feigned attack all the rest hastened to assist in its defence. Thus every ape enjoys the protection of all the remaining members of the horde ; should any beast of prey attack one of them, every able-bodied member of the horde hurls itself against the aggressor (unless the assailant possesses obviously overpowering strength). It is universally related of apes that they carry wounded or dead companions away with them ; according to Brehm, a mother baboon has even been seen to pluck leaves from

the nearest branch and use them to stop a wound inflicted upon her offspring. In case of danger one animal often warns another, and according to Berger a Patas monkey once tried to prevent its master from touching a box which contained a snake (it must, however, be stated that the snake was dead). It may also be mentioned that prairie marmots and vizcachas drag their wounded companions back to their burrows, and even alligators lend assistance to wounded members of their own species. If a vizcachera is overthrown its inmates are dug out by their neighbours.

According to Berger (p. 225), the instinct to help a sick companion is stronger in elephants than in any other species of animal, with the exception of apes. If an elephant is wounded by a bullet others come forward and support it; if it falls its fellows kneel by it, and some pass their tusks under its body while others wind their trunks about its neck and attempt to put it on its feet.

The members of a horde of apes search one another's coats for burrs and thorns after a flight. This habit must not be confused with that of hunting for lice, which the apes commonly practise upon one another, but which they will practise upon men, if allowed to do so. Brehm interprets the habit (vol. 13, p. 436) not as a search for vermin (and not, therefore, as a form of mutual assistance), but as prompted by a taste for licking the small salt particles of skin which peel from the body (i.e. as a form of self-indulgence). It has been proved that the skin parasites escape unharmed.

Members of most animal societies display jealousy of their companions over questions of food (apes, beasts of prey,

etc.), though it is true that two apes, close friends of one another, will share their food. The most conspicuous feature of the behaviour of hens in a flock of fowls is jealousy; the cock alone remains indifferent to their brawls; he exercises despotic sway over every hen, and even entices them to any spot where food happens to be particularly plentiful.

Mutual help very often occurs in connexion with pairing and brood tending. The male protects the female, and either one or both of the parents defend the offspring. Young animals which have lost their mother are sometimes immediately adopted by another female (e.g. among elephants, wild pigs, quails, and some ducks). It is well known that the maternal instinct in cats is so strongly developed that one can impose upon them the young of widely different species, namely, young rats, mice, rabbits, hares, dogs, foxes, squirrels, etc. According to Brehm, some parrots, when kept in captivity, take over the care of young or crippled birds of their own species or even of animals of a different race, feeding them and defending them against aggression. As we shall see later, however, this does not always happen, and it is even possible for the contrary to occur.

Female apes, too, when kept in captivity, will grudge food to their own offspring; the nature of the environment, which is always unfavourable, though in varying degrees, is probably responsible for this behaviour. Foster children, adopted to satisfy the maternal instinct, are especially liable to suffer from this behaviour. Sometimes, even, they are altogether refused access to the food.

It cannot be denied that apes possess a certain tendency to cruelty. We must nevertheless be particularly careful when discussing this topic ; for much which may seem at first sight to proceed from an instinct of cruelty—an instinct which makes torture an end in itself—on closer examination proves to be bound up with the biological necessities of the species concerned. Thus it is highly debateable whether a full-grown cat playing with a mouse affords an instance of deliberate cruelty ; quite possibly, the cat is simply keeping in practice. This is certainly the correct interpretation when a mother cat carries to its young a half-dead mouse for them to practise on. But whoever reflects on the impossibility of disentangling the skein of human motives, will hardly deny that, in the play of the full-grown cat, there may be a sort of sport and will-to-power. Many intermediate stages exist, nevertheless, between this latter impulsion and genuine cruelty.

The games which even full-grown apes will play together are not always quite harmless, especially when some of the players are stronger than others. Apes often show a propensity to tug a companion unexpectedly by the tail or by the hair. In every monkey cage each animal occupies a clearly defined rank, and the larger ones will tease and torment those of a smaller species in every conceivable way, seizing them, for instance, by the tail to send them flying through the air. Yerkes (1916, p. 121) noticed a young ape gleefully inciting his companions against one another. The animal in question pretended to have been attacked by another ape ; as soon as the elder ones had come to blows, it withdrew to a safe distance and watched

developments. Brehm describes how a baboon teased a dog by pulling its tail and then running away, repeating the trick until the dog was beside itself with fury. Apes are particularly fond of chasing and intimidating fowls. In considering these cases it must, however, be remembered that the apes being in captivity are, so to speak, condemned to idleness. They are cut off from all the normal activities which they pursue in a state of freedom, and their energy has to seek an outlet in other directions.

When in Köhler's experiments, the apes piled two or three boxes on top of one another in order to reach food hung above their heads, although they helped each other to do this, their actions were prompted rather by their common anxiety to get at the food than by any more altruistic motive. Ordinarily they were far more inclined to hinder than to help one another. When one of the animals was at work, perched high upon a rickety erection, the unoccupied chimpanzees would steal up behind and give the boxes a vigorous push, thus upsetting the whole structure and bringing the worker to the ground; they would then make off with all possible speed.

A sick or wounded animal is often turned out of a society, i.e. ostracised, or even killed. Alpine marmots gather together before going into their winter quarters and, according to Girtaner, it sometimes happens then that a number of them attack, and bite to death, an old and decrepit comrade. The biological significance of such a "weeding-out" is obvious, for if one of the animals dies during hibernation the corpse is a danger to the whole community. Beavers have been seen to bite and drive

out of their colonies certain of their fellows, both young and old. Animals thus expelled live thenceforth alone in a separate structure. Many tales have been told of the so-called "stork tribunals", and "executions" among other animals. The following, however, is ascertained truth. A number of cranes have often been seen to fall upon one bird while the flock is resting, and inflict such severe blows upon it with their beaks as to lame or even kill it. Storks collect in large flocks before migrating, and expel or even kill those which are sick or incapable of making the journey, or which have been tamed by human beings. Ravens, cranes, and many other birds, hares and roebuck show themselves hostile to tame members of their own species (Naumann, vol. vi, p. 305 ; vol. vii, p. 104). Many birds will not suffer the presence of companions with gun-shot wounds, but kill them outright. Brehm relates that a parrot, after being wounded, was ostracised by its companions ; it then lived alone until it was put to death by some other parrots. The "execution" of single animals is occasionally met with among many beasts of prey, and even among domestic cattle ; Gross (p. 228) is of the opinion that not all these cases are to be explained as the working of an instinct having as its object the preservation of the species ; it would be sufficient for this purpose merely to expel any animal whose presence endangered the life of the community and leave it to its fate ; he thinks them often due rather to an instinct of destruction.

Cannibalism, or the killing and devouring of each other by members of the same species, is of frequent occurrence

in the animal kingdom. For this, of course, one of the creatures must get a hold on the other ; the animal attacked must therefore be either the weaker of the two, or somehow prevented from defending itself. Among solitary predatory species (worms and other of the lower animals, insects, crayfish, reptiles, birds of prey, shrew-mice, predatory mammals), animals belonging to the same species never spare one another ; e.g. the male hamster even bites the female to death if they encounter one another outside the breeding season, without, it is true, troubling itself further about the corpse. Some species even devour their own offspring ; in particular, the parent which does not concern itself with the rearing of the brood is a danger to its own young (fishes, crocodiles, predatory mammals) ; among fishes, however, the parent which does tend the brood may devour its young after they have reached a certain size. The male budgerigar, which helps its mate to feed the young birds as long as they are in the nest, sometimes ill-treats and even kills them after they are fledged. Similarly, unmated female budgerigars are also a source of danger to young birds of their own species. Parent ostriches bite and kill the offspring of other birds ; among gallinaceous birds the females peck to death chickens belonging to other hens ; unmated ostrich hens do the same and half-grown ostriches deal similarly with younger members of their own species ; the turkey-cock kills his own young. In exceptional cases, ostriches driven from their nest will destroy their own offspring. The biological significance of such behaviour escapes us.

Cephalopods (cuttlefish), living under natural conditions,

eat one another ; if, for instance, one of a number is hooked by a fisherman, its companions immediately seize upon it, and may even allow themselves to be drawn to the surface clinging to its body. Caged owls live peaceably together as long as they are all equally strong and healthy, but if one falls sick it is immediately attacked and eaten by its companions ; and this holds true even when the owls come from one and the same nest. If a musk rat, a brown rat, or a water rat is caught in a trap it is torn to pieces alive, and devoured by its fellows. To pinch the tail of a caged rat until it squeaks with pain is sometimes enough to induce its fellow prisoners to fall upon it and bite it to death.

The mutual help which is a feature of the life of an insect state has already been described. As I have said, the habit of licking each other must be regarded, not as due to a desire for cleanliness, but rather as a means of procuring the skin secretions which are the object of the licking. But there is a limit to mutual help in these insect states ; whilst it remains true that under certain conditions sick and wounded ants are tended and licked, they are just as frequently left uncared-for, or carried off to the rubbish heap. Sentiment plays no part in the organization of these states ; only those insects which work for, or will in future work for the state, are tended and protected ; the common-weal alone determines life or death. Here again let it be emphasized that neither intelligent reflection nor a majority of votes govern insect states, but sureness of instinct and the limitations of instincts to specific purposes, things which appear fabulous to us as human beings.

Any individual belonging to another nest, or lacking the special nest odour, is put to death. The queen bee kills all rivals; once the queen has been fecundated the workers expel the henceforth superfluous males from the hive. Queen ants also commonly fight one another until only one remains alive. If times are hard the worker ants may kill every queen but one (Escherich, p. 86). Many of the eggs are eaten by the ants, an insect often eating those it has laid itself. Termite workers take good care that the numerical proportions of the "castes" are correct; superfluous insects are killed and eaten (Escherich, p. 22); a similar fate overtakes their dead or diseased comrades.

C THE COLLECTIVE MIND

Mass psychology, as is well-known, proves the truth of the dictum that the whole is not merely the sum of the parts. In other words, the collective effect, obtained by the co-operation of individuals, can never be inferred from the mere summation of individual achievements. Thus the mass, or collective action M , cannot be ascertained by adding together the single actions of the individuals, A , B , C ; their co-operation produces a result *sui generis*. The equation then is not:—

$$M = f(A) + f(B) + f(C)$$

but—

$$M = f(A, B, C).$$

The importance of the individual in contributing to the collective result depends upon the part it plays in the community. In certain cases the individual determines the life or death of the whole community, as, for instance, in the case of a bell wether jumping into an abyss.

Among social species courage and pugnacity grow in proportion to the number of individuals present ; this is true of ants, bees, humble bees, wasps, hornets, and others. In the case of the honey bee, a small and weak community often does not defend itself against enemies which it could easily repulse, whereas a strong community is always ready for attack, and expels every intruder (*v. Buttel-Reepen*). According to *Forel*, one and the same ant which is full of courage among its fellows will take to flight before a much weaker adversary as soon as it finds itself alone. State-building insects are overcome by profound depression if their nest disappears.

Song birds, and other small birds, when united, "tease" birds of prey, i.e. defend themselves to the best of their ability against them, not only in our own country, but in other lands and latitudes. Single sea-gulls and crows are powerless against many kinds of enemies ; but, united, the members of a colony of crows or a colony of sea-gulls often wage war against birds of prey. A herd of horses or domestic swine will attack a wolf, whereas a solitary horse or pig is generally lost. In the same way wolves are much bolder when hunting in a pack than when hunting alone.

When many individuals are together the action of a few sometimes carries away the whole group. In warm weather, a large number of locusts sitting closely packed together gradually become more and more excited ; until suddenly they all take flight together, attracting to their ranks every member of their own species they overtake so that the swarm grows larger and larger. (*Brehm*, vol. ii, p. 96.) Migrating swarms of dragon-flies are formed in this way, as are the

swarms of locust larvæ which travel across the ground. Similarly among ants the excitement of the males and females preparing for the nuptial flight communicates itself to the workers, and no work is done until the last of them has flown. According to Stresemann a flock of birds increases because of the fascination exercised on the individual by the mass; sometimes even a pair of birds leading a solitary life will be carried away by the spell.

Köhler noticed that if one of his chimpanzees was attacked the whole group immediately hastened to its aid. During a fight the animals would scream themselves into ever-increasing fury. Sometimes a single cry of indignation was sufficient to set the whole band in an uproar, although perhaps the majority of the animals had seen nothing of the original cause of the trouble, which might have been either a genuine attack or a mere misunderstanding.

Panics frequently take place among social animals. Tame doves may be thrown into a panic during the night if one of their number happens to flap its wings (Whitman). The half wild horses of South America are sometimes seized with panic. Hundreds and thousands will suddenly take madly to their heels, cast themselves against rocks and precipitate themselves into chasms. Any carriage or saddle horse belonging to travellers who happen to be resting near is drawn into their flight. Sheep take madly to flight before wolves, and, in Australia, before the wild dogs (dingoes) of the country, straying so far afield that they often perish. Schillings relates the following anecdote of an old male baboon chained in front of a fort in East Africa. On one occasion the whole black population of the station, expecting

at any moment to be attacked by enemy tribes, fled to take refuge in the fort ; the baboon, seeing this, tore itself from its chain and fled with them to shelter.

Some actions are performed with much greater energy when they are carried out by a group of individuals ; this is notoriously true of singing and dancing, both among men and beasts. It is also true of gregarious animals when they are feeding ; farmers know that some beasts, e.g. horses and pigs, especially when young, eat more if fed with their companions. I have even heard a human mother say that it was better for her children to have a table-companion as otherwise they ate too little. In all these cases we observe the working of that instinct which lies at the root of the pleasure taken by adult human beings in banqueting and other social entertainments.

D COURTSHIP AND DANCING

At pairing time more or less serious battles develop between the males for the possession of the females, not, it is true, among lower animals, but among the arthropods and the vertebrata. These are accompanied by a display of those arts by which one sex seeks to please the other ; rivalries between males at times constitute an art of wooing. It sometimes happens that the fighting loses its original significance and is no longer undertaken solely in order to dispose of a rival but becomes an end in itself ; in this case the battle becomes a sport, which may be serious or quite innocent. Finally the bodily movements, originally employed either in fighting or in wooing, may become freed from all

sexual meaning and so conventionalized as no longer to express anything more than a sense of enhanced vitality.

Among insects male stag beetles sometimes fight to the death, as do also male ground wasps, solitary bees, and others. Male fishes often fight each other fiercely ; the victor disports himself amorously before the female, or they dally together for a while until eventually the female lays her eggs and the male immediately fertilizes them. The fighting fish *Betta* is so markedly pugnacious that in Siam the natives match them together for sport. Male amphibians fight with less ferocity, in fact, they do little more than jostle one another. Male reptiles, on the contrary, may be much fiercer, as also some birds and mammals.

The characteristic features of the courtship and pairing of many species of birds and mammals are well-known. On the whole the male is more striking, stronger and more aggressive, and does the fighting and the wooing, while the female plays a more passive part. Among *turnices* and *phalaropes*, however, the females are more brilliantly coloured and larger than the males, they alone play and dispute over the possession of the males, and the male undertakes the rearing of the brood single-handed. Among pheasants it is rather the females which seek the favour of the males than *vice versa*. Among condors both sexes dance. The female bird emits a characteristic mating cry which obviously acts as a sexual stimulant upon the male, and among roes the " piping " of the females is an invitation to the male. Among human beings, too, we see that the female sex very seldom contents itself with playing a purely passive part.

The fighting principle is often carried to excess by some male birds and mammals. Thus, during pairing time, male chaffinches live in a state of constant hostility towards each other, either singing against one another or actually fighting, although this behaviour is quite uncalled for, since the females meanwhile sit in peace and unmolested in their nests. The tapping of the male woodpecker has the effect of attracting rivals; this tapping is characteristic of the species in all latitudes, although it varies a little in different zones; it might be described as instrumental music, and the woodpeckers of our own country produce the sound in this way; the male suspends itself from a dry branch and taps it with his beak so hard and so quickly that the branch quivers to and fro: the noise of the hammering beak and the quivering branch together combine to produce the well-known rattle.

The battles which occur among stags at rutting time seem to be undertaken entirely for their own sake, for a stag on hearing the bellow of a rival will leave his harem in the lurch and set out to find the challenger. Here fighting has become a sport, though, as is well-known, such battles may have a fatal issue. Fights of this kind, but varying in severity, take place among many species of horned and antlered mammals, when the males are in heat. Bison steers, when frantic with desire, will root up comparatively large trees, and at rutting time one often finds both bulls and cows which they have killed.

Some birds play fighting games of a harmless nature. Among ruffs (*Machetes pugnax*), which mate promiscuously, during the spring the males collect every day at a certain

spot to play the fighting game ; females seldom join them, but when they do appear they strike the attitudes of the male and pretend to join in the fray. In these fights, which although they appear to be very fierce, are never, in fact, serious, there is neither victor nor vanquished ; just outside the fighting ground several males are often to be seen keeping company peacefully with a single female, and no signs of real jealousy between males have ever been observed. The original biological importance of the fighting instinct has, in these cases, entirely disappeared.

In spite of the apparent ferocity with which black cocks attack one another on their dancing grounds, it hardly ever, perhaps never, happens that a bird is seriously wounded ; among capercaillies, on the other hand, the males fight one another in earnest. Some black cock will visit several dancing grounds in the course of a single morning. In countries where black game is abundant, several cocks always appear simultaneously at a dancing place, where they fight each other and dance in each others' company ; fighting and dancing have become indistinguishable. The fight is just acted and serves no other purpose than to increase the sexual excitement of both males and females, and this may be affirmed in general of the fights, sports, wooings, and dances of birds.

White mews (*Rupicola*) play a kind of dancing game in which a male dances alone upon a piece of rock watched by a number of males and females perched upon the branches of bushes nearby. Each male dances in turn, and the females set up an outcry whenever one relieves another.

According to Hudson, certain South American giant rails

(*Aramides*) collect from time to time at fixed places and perform a kind of pairing dance in which both sexes take part (Doflein, fig. 383). The contagious effect of collective performances turns these dances into "mass games of an orgiastic nature" (Groos, p. 232). According to Groos, we have here an instance of that stimulation of sexual excitement by imitative suggestion with which ethnology and the history of civilization have long since made us familiar. Jacanas dance in the same way (Doflein, fig. 384). According to Hudson, the South American spur-winged peewit (*Belonopterus*) performs a dance which is so far peculiar to that species that it is always performed by three birds together (Doflein, illustration 385). This species lives in pairs throughout the year; but the different couples keep close to one another and from time to time one of a pair will visit a neighbouring couple, whereupon the dance is immediately begun. The three birds fall into line one behind the other, and march forward, keeping step and uttering cries in time to their paces; then they stop and the leading bird stretches itself to its full height and sings loudly, while the other two bow their heads and utter gentle notes. After this the performance comes to an end, the visitor returns to its mate and sooner or later receives a similar visit. The existence of the winged spurs perhaps indicates that the game was evolved from real fighting (Haecker). Hudson believes that in the case of *Belonoptera* there is no longer any connexion between this dance and the sexual life of these birds, since the dance is performed at all seasons of the year.

The males of different monogamous species of birds of

Paradise arrange dancing and pairing parties in special trees and at special times of the day when the breeding season begins. The trees to which the birds betake themselves then appear one mass of waving feathers ; the females are merely spectators of the proceedings.

At pairing time each male bower bird, helped by its mate builds on the ground a " playhouse " of twigs (Doflein, illustrations 386-9). This bower serves no other purpose than that of a theatre for their courtship, the actual nest being built in a tree. It has both a back and a front entrance, and is decked with all sorts of coloured or striking objects (feathers, shreds of cloth, snail shells and mussel shells, bleached bones, etc.) : the feathers being stuck among the twigs, and the bones and rags laid before the entrances. These decorative objects are often brought from miles away. The bowers seem to be used several years in succession. In one species they are covered outside with long blades of grass laid neatly together. Carefully selected stones serve to keep the twigs and grasses in position. In this species, moreover, several males use the same bower. The gardener bird (*Amblyornis*) decks the space in front of its bower with coloured berries and flowers, and these, when faded, are thrown on a rubbish heap behind the bower and replaced by fresh ones. One particular male of a certain species was observed to drag a long, dead, and dried up centipede to the playing ground every day and wage with it a mock battle before the eyes of its mate and other birds.

Among the phenomena accompanying and succeeding pairing, when wooing time, in its strict sense, is already over, are many tricks of flying practised by the males, and

sometimes by both sexes ; thus most of the larger birds of prey and also storks are accustomed in spring to fly in wide circles over the nesting places they have chosen.

Among cranes, which are birds of very high mental development, the dance has lost its wooing significance, and has become merely an expression of general well-being. Both males and females dance. The movements in this dance are executed for their own sake ; i.e. the birds play (Groos). " Demoiselle " cranes (*Grus virgo*) dance and play together in the following manner ; they collect on the steppes, form a circle, bow to one another, and dance in a fashion that is truly grotesque. Soon after pairing, too, they meet together morning and evening to dance and hop round each other, lifting their crests and their wings, and then fly around in wide circles. After a few weeks, when actual breeding begins, the birds cease to collect together and are only to be seen in couples. The keeper of a captive crane (*Grus grus*) induced it to dance by making the appropriate movements.

The arts of courtship, although not confined to birds, find their most elaborate development among them. To mention but a few other examples : the male uca has one claw much larger and more brilliantly coloured than the other, which is used for beckoning to the female. Male antelopes engage in mimic battles, and male springbucks perform certain conventionalized movements in the presence of the females, springing about six feet into the air in a rigid posture and displaying their white manes.

Among the chimpanzees at Teneriffe, Rothmann and Teuber saw a male dancing in a triple rhythm close to a number of females ; and the sexual significance of its move-

ments was obvious. One of the females also performed dancing movements in the presence of a male; the resemblance between these dances and those of primitive races was very marked. Köhler watched his whole group of monkeys, playing, dancing, and leaping about without being able to detect any erotic element. These dances had not been learnt by imitation, and the animals welcomed to their dance their human owner whom they knew to be their friend.

How far dancing and the arts of courtship are traditional among animals or how far they must be regarded as purely instinctive is not yet known. It is, nevertheless, safe to assume that pure instinct preponderates ($C > V$). The presence of other animals is a necessary condition of the self-display in pairing dances and in the dances evolved from wooing movements. Here we find one of the fundamental reasons why human beings seek an audience for the display of their æsthetic activity (Gross). The peacock spreads the splendour of its tail whether the onlookers be swine or men (Darwin). Yet in singing birds the impulse to sing is so strong that it asserts itself even when they are alone. When singing, dancing, or flying games are performed in common, they may legitimately be described as forms of social self-display.

E PLAY

The cause of play is the impulse which drives every animal to be doing something; the purpose of play, especially during youth, is often the acquisition of skill in some activity useful to the animal; on the other hand, play may be an

end in itself. In the case of some animals (young birds and mammals in particular) and children, this joy in activity is at first aimless ; but as the child or the animal grows older, under the guidance of parents or teachers the activity pursues more and more definite aims, and in various ways assumes biological significance. Not infrequently play becomes merely a preparation for the so-called struggle for existence. It practically vanishes at the age of sexual maturity and gives way to purposeful activities, and in the domain of sex, love games takes its place. It has in itself no sexual reference, but it may acquire this character. When full-grown, children and animals distinguish without any difficulty between jest and earnest ; while playing they are always conscious of acting a part ; a dog at play only pretends to bite. It is, however, well known that jest may pass through various intervening stages to earnest.

An attempt has been made to derive the artistic activities of human beings from their play ; but this is inadmissible. It is true that the artistic impulse of primitive man may originally have expressed itself in play, as it does at first in the case of children. But later, with the progress of distinctively "human" development, the impulse has expressed itself more and more as a law to itself, and has produced the phenomena now found among the various races of man. Whoever would regard art as a development of the play impulse, must also regard all technical knowledge and skill, and finally all vocational human activities as having the same source ; for each of these occurs somewhere and somehow in the activities of children at play. To derive the artistic impulse from the play impulse is to confuse the

latter with the universal desire to be doing something and to fall a victim to that endeavour which, in its extreme forms, can only be called a mania for derivation, and which consists in the effort always to refer one phenomenon back to another.

When Köhler's young chimpanzees were handling objects their activities almost always came under the heading of play. If during an experiment a novel form of activity was demanded by some necessity or other, it was quite certain that the innovation would reappear very soon afterwards on some occasion when the animals were "playing", i.e. in circumstances where it had no practical utility, but was merely the expression of enhanced vitality. On the other hand, among the many games in which the monkeys made use of objects, some could easily be diverted into useful channels, as for instance stick-jumping, or digging with the said sticks. How the use of a tool might, in certain cases, have its origin in a game, may be told in Köhler's own words: "I certainly do not wish to maintain that the chimpanzee one day takes its stick, and so to speak, says to itself—of course, it cannot talk—'There, now I will dig for roots.' But no observer can doubt that when it has been digging in play, and has by chance come across roots, it will go on digging for them because it had long used its hands for this purpose, and now has discovered a better method."

The most intelligent animal was usually the moving spirit in the invention of any new game, and although in their play Köhler's chimpanzees constantly adopted new crazes, they never imitated human activities. One of their favourite forms of activity was to prize off the covers of the drain

pits, using sticks as levers. The attraction did not lie in the foul contents of the drains so much as in the possibility of smashing something to pieces. According to Köhler, if a chimpanzee is confronted with something destructible it will not rest until the object cannot be further broken up, or is not worth breaking into smaller pieces.

Ladling liquid with bits of straw, small sticks, and so on was often undertaken in play, even when the animals had free access to water while feeding. Another fashion was catching ants on small sticks and straws. One particular animal invented this game, and the others quickly followed its example. A straw, or something of the kind, was held across the path of the ants, and when covered with the insects was drawn through the mouth. Köhler thinks that the sporting interest more than equalled the appetite for ants; as long as this sport was in fashion the chimpanzees were always to be seen crouching together over the pathway of the ants, each animal with a straw of its own, looking like a row of fishermen beside a river. For a time the fashionable game was poking the fowls with sticks. The fowls were either decoyed, or actually fed, with bread, and then poked violently with a stick; this game was sometimes played by two chimpanzees together, one of which fed the fowl while the other poked it.

The chimpanzees were very fond of fastening, in some way or another, a variety of different objects to their bodies. Nearly every day Köhler would see an animal going about with a cord, a shred of stuff, or a twig upon its head or shoulders. The animals would play, not only with the objects but with each other, and it was plain that the

drapery in some way added to their pleasure. This primitive form of adornment was not intended to produce an effect on other animals ; its sole result was an increase of self-consciousness in the wearer (the sort of feeling aroused in human beings by the wearing of a scarf, a sabre, or a top hat).

In interpreting the above games it must be borne in mind (1) that the chimpanzees were still young, and (2) that they were divorced from their natural surroundings, and that foraging was no longer a necessity ; they were, so to speak, unemployed, and play was the only available outlet for their active impulses. It is probable that chimpanzees living in their native forests are much less given to playing.

Speaking generally, it is especially young animals which play together, but older animals do so too. Full-grown apes in their native forests romp together in a way that can only be described as a movement game. Not only members of the same species, but members of different species will play together, especially in captivity. Nevertheless, great care must always be taken to avoid any confusion between real hunting, pairing dances, etc., and genuine play. Play often contains an element of rivalry, e.g. in sham fighting and in hunting games.

We may follow Groos in distinguishing three types of the latter, those with living prey (cat and mouse), those with living mock prey (one dog pursuing another), and those with inanimate mock prey (ball games).

According to Pfungst, young wolves and dogs organize fighting games and hunting games with mock prey, which may be either alive or dead ; and during these games young

wolves display the rudiments of retrieving, although they lack all previous training. According to Brehm a young orang outan clearly showed itself to be peculiarly attracted to small children, since it often tried to induce them to play with it by offering them its own playthings. When this orang utan saw itself unexpectedly in a mirror at first it took to its heels, and repeated this several times ; it then spat at its image and pelted it with all sorts of objects. In the end, however, it tried to induce its own image to play with it.

According to Schmidt, when kittens play it is partly at the instigation of the mother cat, and partly of their own accord ; the mother brings a half-dead mouse, or something of the kind, and the kittens then practise upon it. Among apes, on the contrary, according to Pfungst, games between a mother and child are always started by the latter ; the accounts of von Allerssh seem, however, to indicate that among chimpanzees, in any case, the initiative is sometimes taken by the mother. Dogs, because they are more sociable, indulge in play to a greater extent than cats. Dogs, cats, apes, and other mammals play more often, and more wholeheartedly, with children than with adults, and put up with more from children ; they manifestly possess a certain understanding for the helplessness of childhood. If young mammals turn their play into earnest the mother not uncommonly separates the disputants.

Brehm describes a certain mode of behaviour found among chamois, which can only be described as play. When left completely undisturbed, chamois will squat on their haunches and slide, one after another, down slopes of snow

for a distance of a hundred to a hundred and fifty yards, then climb back to the starting point, and begin the slide all over again.

Schjelderup-Ebbe describes a kind of game, possessing a certain sexual implication, found among wild duck, which are monogamous. This author watched a mated female amuse herself on several occasions by fooling unmated males; she would fly towards them, but always retreated to safety as soon as they began to pursue her.

It cannot be doubted that ants play at fighting; the fact has been demonstrated by Huber, Forel, MacCook, Bates (quoted from Groos, p. 147; Escherich, p. 188; Forel, vol. iii, p. 88).

F UTTERING SOUNDS IN CHORUS

In the animal kingdom sounds are uttered in chorus, sometimes from pure imitation, sometimes as a group signal, and sometimes without any definite motive. There is, further, the alternating song of rival males, and the cry of greeting by which excitement is expressed. These categories are often not separated from one another by any sharp line of cleavage.

If a lion, either caged or free, begins to roar, any lions in the neighbourhood immediately join in. A donkey braying will set every other donkey within hearing braying, too. Similarly a whole herd will bellow or howl when any one animal gives the lead. Male frogs, inhabiting the same pond, croak or are silent together, and even outside the pairing season croak in chorus. The noise in the bird houses of a zoological garden, where a bird is always prompted to

become vocal by the noises uttered by the rest, is known to everyone. Any noise may induce caged birds and tree frogs to sing or croak, while dogs begin to sing or howl when they hear music.

Wandering bands of animals emit call-notes continuously, e.g. the mixed bands of titmice, common creepers, woodpeckers, and golden-crested wrens. These group signals serve to keep the company together. Spring and autumn migrations are, on the contrary, carried out without calls ; it was a mistaken idea that the flocks are then kept together by such signals. When migrating, birds cry out only when bewildered or frightened, as, for instance, when they fly into the rays of a lighthouse, or over brightly lit cities, or when in daylight they catch sight of men. Like these titmice flocks, small groups of Marmosets traversing virgin forest continuously emit a thin piping or twittering sound. Among *passalides*, or wood-boring beetles, mentioned several times already, where the two parents lead the family of larvæ, the members of the group give out a continuous chirping which keeps the band together.

Calling to each other in turn is a feature of the contests between male birds (e.g. among domestic cocks). The sounds emitted by *Tamias* are probably without any sexual meaning. About half a dozen each perched upon a stone, or other similar object, will chirp to one another hour after hour ; a distinct rhythm can sometimes be discerned in these sounds.

A pair of brooding cranes will send a cry of greeting to others of their own species passing in the air above ; two flocks of parrots will acknowledge each other with ear-

splitting shrieks. Two bats will call to one another if they chance to meet, and two swallows will do the same.

The sounds emitted by many kinds of apes form a genuine chorus. Thus a group of howling monkeys (*Alouetta*) do not set up a merely senseless howling, but really observe certain rules. The leading ape, an old male, acts as precentor (the Brazilians, on this account call him the "chaplain"); he begins with short staccato notes, and gradually lets his voice swell out into an organ peal. The remaining members of the band join in later with short phrases, but always limit themselves merely to the provision of an accompaniment. From time to time they all fall silent, then the leader begins again, and the concert proceeds as before. One and the same herd has sometimes been noticed to possess two choir leaders.

Among chimpanzees living in their natural surroundings an old male will begin intoning in a deep bass, and the whole troop will then join in; the voices swell into a fortissimo and then gradually diminish until the concert dies away in the sounds emitted by one animal alone. This chanting takes place just after the animals wake, and while they are still in their nests; it is also heard during the search for food, and especially on moonlight nights. *Colobus* monkeys sing in chorus during the day, particularly at dawn, in a manner peculiar to themselves; the song begins softly and gradually attains considerable power; if interrupted it is always taken up afresh shortly afterwards. South American sakis (*Pithecia*) come out of the forest morning and evening, collect in large herds and fill the air with penetrating cries. Gibbons and other species are also accustomed to emit

hideous shrieks at sunrise and sunset. A characteristic feature of these choruses is that the apes always remain in the same spot while performing them.

G PROPERTY, PROVISIONS

Some animals at breeding time take possession of a particular domain, where they build their nests. Thus when pairing time begins each male stickleback lays claim to a special abode from which it drives away all other fishes. In an aquarium the boundaries of one male stickleback's domain are marked out from those of the rest only by fierce fighting. The females live meanwhile in swarms near the surface, and are fetched by the males to the nests each time they lay eggs.

In most bird species every pair lays exclusive claim at least to its own nest, and often to a certain radius round it as well. This domain may be either a bush, a piece of ground, a swamp, a small pond, or part of a stream; the latter applies to moorhens (*Gallinula chloropus*), coots (*Fulica atra*), swans, and others. Thus the male wild duck drives every stranger of its own sex and species away from the brooding place; in these struggles strange females may very likely be violated by force (von Geyr). When the pairing season is over the brooding place is, in many cases, abandoned, as happens among numerous species of thrushes, robins, dippers (*Cinclus*), different finches, cranes, swans, pond fowl, and water fowl. During the pairing season each male cuckoo occupies a sharply circumscribed domain; the females rove from one male to another. One and the same male has been seen for decades in the same spot, and the

females, too, return again and again to the same region. Every male nandu, with his harem, is master of a particular portion of land while the breeding season lasts. Although wild geese breed gregariously, each pair, nevertheless, claims as its own a certain area around its nest, and does not admit strangers within it. In a penguin colony each rectangle, bounded by pathways, belongs to the pair owning the nest built therein.

On the other hand, many birds of prey lay claim to the same domain throughout the year, that is to say beyond the brooding period, and suffer no rival within their boundaries. Thus every pair of eagles of the species *Haliaetus vocifer* rules a district about three kilometres in diameter. This is also true of other eagles, falcons, secretary birds, etc.

We also find the principle of territorial rights developed among some mammals. Every horde of apes possesses, as a rule, a clearly defined domain whose extent varies in different species. If two hordes encounter one another fierce fighting may ensue. Each herd of kangaroos possesses its own grazing place; sometimes it possesses several, linked together by well-trodden paths. Herds of North American, prong-horned antelopes each inhabit a definite tract of country within which they travel long distances. In oriental cities every alley has its own half-wild dogs which do not dare to leave its shelter, since any dog entering a strange alley is attacked and torn to pieces by the dogs domiciled there.

Every ant-state has a special hunting ground, and if an ant belonging to one state trespasses on the territory of another a battle follows, the result of which is usually the

retreat of one of the parties ; it very seldom happens that two neighbouring states become used to and tolerate one another. On the other hand, the bee-states have property rights only within the hive ; the tracts of country where food is to be gathered are open to the members of any hive.

It is therefore no uncommon occurrence in the animal world for a single animal, a pair of animals, or a whole company to occupy either for a time, or permanently, a clearly defined domain. It happens less often that an animal looks upon some object as its own personal property. But some apes, for instance, will treat a plaything as their own. Brehm speaks of a captive baboon which took a tin can and other similar things with it to its sleeping place, and hid them there. A captive long-tailed monkey regarded as its own property, and used as playthings, rubber balls, corks, and bits of wood, etc. One or other of these objects was always for a time the most important (or, in other words, was the fashion), and was carried at night to the sleeping basket ; the others were carefully hidden behind and under cupboards, etc. The monkey regarded these objects as its own property and resented any attempt to touch them or take them away as an unjustifiable infringement of its rights. The animal was also in the habit of lodging smaller objects in its cheek pouches.

Some animals, both solitary and social, lay up stores of food over which they possess more or less clearly marked property rights. According to Schillings, when a leopard kills, after devouring the heart and the liver, and burying the entrails, it places the rest of its prey in storage among the branches of a tree or a bush, sometimes at a considerable

height. The solitary and extremely unsocial hamster constructs one or more store chambers in its dwelling ; the mole, likewise a solitary creature, collects earthworms, and bites off their front ends to prevent them from escaping ; the squirrel, too, conceals provisions. Certain owls which always live alone bring back food and store it if their hunting has been particularly successful. A pair of shrikes (*Lanius*) usually store their prey (insects, amphibians, reptiles, small birds) on thorns all over their hunting ground.

Central American woodpeckers (*Melanerpe*) combine together to lay up stores for the winter, pecking holes in the bark of trees, and there hiding acorns. After the lapse of some weeks the whole flock returns and consumes the supply. Piping hares (*Ochotona*), which live together in colonies of burrows, collect great stores of hay, piling it up, and covering it during wet weather with broad-leaved plants. Alpine marmots live alone or in pairs in their summer nests, but in winter from five to fifteen of them inhabit the same nest, and these winter nests contain stores of hay.

How state-building insects collect and store food has already been described in detail. Male and female apothecary beetles (*Ateuchus sacer*), which live together in pairs within associations formed at some favourable place, make balls of dung and roll them hastily into holes previously prepared. During the process of conveying these balls to the burrows, their possession is fiercely disputed by other beetles. When the ball is safely housed, either the couple who made it devour it, or the female lays a single egg upon it, and the ball later serves to nourish the larva after it has been hatched.

IX GENERAL ANIMAL SOCIOLOGY (*continued*)

H MUTUAL UNDERSTANDING AND IMITATION

As long as men alone are under consideration imitation and mutual understanding are two conceptions which seem to have little connexion with one another. But when we turn to the animal world we see that means of communication often merely lead animals to imitate some action performed by another. Behaviour of this kind lies midway between pure imitation, which is always spontaneous, and mutual comprehension of a higher order.

Pure imitation plays a great part among social animals. If one animal gives out its cry the rest usually follow suit ; such activities as running, flying into the air, consuming food, basking in the sun, etc., are all contagious. It is well known that the social instincts of some birds play tricks with them, and that hunters may lure them to destruction with the help of a decoy bird. If a young bird in the nest stirs its wings the rest of the brood immediately does the same. When penguins are hesitating at the edge of the ice, if one bird takes to the water all the rest follow its example. Zebras are very difficult to tame, and are taught their circus tricks by being given trained ponies as "instructors". Captive gnus can be induced to make their peculiar capers if their keeper will jump into the air in front of them, and cranes will dance if appropriate movements are made before them.

The force of example is familiar to us from our acquaintance with our fellow creatures; the infectious nature of yawning, eating, etc., is almost proverbial. In theatres and at concerts the audience lets itself be carried away over and over again by the persistent applause of one or a few. Talking is also infectious, and it is impossible to deny that human conversation rests upon the same instinctive basis as the social sounds produced by animals. For it is frequently practised, not with the object of imparting conversation, but for its own sake, as an expression of sociability.

Köhler could make every chimpanzee in the station look in exactly the same direction by suddenly behaving as though he were extremely frightened, and riveting a spell-bound gaze on a particular spot. All the chimpanzees would then run together as though thunderstruck, and stare at the same spot, even though nothing whatever was to be seen there. It is common knowledge that anybody can make the same experiment at any time with his fellow men by staring fixedly at a portion of the pavement, or into the air.

Apes possess, in a high measure, a propensity for imitation. According to Rothmann and Teuber, the Teneriffe chimpanzees learnt by watching alone to open doors, to insert a key in a lock, and to regulate the flow of a water supply by a valve. The chimpanzees tried to scrub the floor boards as they had seen their keeper do, and played leap-frog after watching some children at the game. According to von Oertzen, tame chimpanzees imitated the bodily movements of dancing negro women; they also took an interest in the cowrie shell games of the natives, without,

of course, any understanding of the rules, cleaned their teeth as the natives did, etc. ; and all this came about not as a result of training, but from observation alone. Nevertheless it is unspeakably difficult for the chimpanzee to imitate anything which it cannot in some measure understand. In common with all other animals, it can imitate only those actions which are included among its own entirely spontaneous activities ; completely unintelligent imitation never takes place. Chimpanzees and monkeys in general which have been trained by showmen to perform special tricks because they are so teachable, lead an empty, pseudo-human life, and it is useless to argue from their behaviour to the psychological states of other animals.

The peculiar manifestations of the mass mind are due to imitation and the reciprocal stimulation of excitement. Not only are swarms of locusts, dragon flies, etc., brought into existence by these forces, but by them they are held together, and impelled to uniform movements of flight. Reciprocal imitation is responsible for changes of movement and other joint actions in a herd, or any other group of animals.

It has often been noticed that if a trained wild animal suddenly falls upon its tamer, the rest of the performing animals in the cage join in the attack. According to Sokolowsky, this common action is instigated, not by some mysterious understanding between the animals, but by observation of the movements of the animal which begins the attack. In the same way many of the animals which live in herds imitate each other's movements in taking to flight or attacking, although the majority may remain

unaware of the necessity of the action which prompted the action they are copying. A horse reacts very markedly to the noise of another horse galloping. Frogs living in associations are put on the alert by the noise made by one of their companions taking to the water (the splash sound, Yerkes). Many animals develop a characteristic note of warning ; birds utter a special kind of cry ; chamois and marmots whistle ; the wild rabbit beats the earth with its hind legs, and kangaroos sound an alarm in the same way. Animals, whether social or solitary, often understand immediately a cry of fear or a cry of warning uttered by another species ; one species of bird will take heed of the warning cries of another and mammals take warning from birds. Goats and fowls understand each other's danger signals (Schmid). On hearing the warning whistle of the reedbuck (*Redunca*), not only members of the same species, but waterbucks (*Kobus*), ibis, and herons all take to flight. In East Africa the spurred peewit warns all the animals of the plain of the arrival of a newcomer with its cry, which it utters as it flies from place to place.

Many animals also draw the appropriate conclusion from the flight of others belonging to quite different species.

Cattle heron perch on the backs of wild buffalo and elephants, ox-peckers (*Buphaya*) on rhinoceros, cattle, elephants, buffaloes, antelopes, and giraffes, the dotterel (*Pluvianus*) on crocodiles, the ox-bird (*Textor albirostris*) on buffaloes. These birds search the hides of their hosts for parasites, and warn the great beasts of the presence of intruders by flying away, and sometimes by cries as well. This warning is not, of course, given intentionally. The

process is reversed when hunters are guided to the resting places and travel routes of wild animals, especially those of elephants and buffaloes, by watching the movements of the cattle heron (Berger). When the ox-pecker keeps company with tame cattle it shows no fear of men ; but when it allies itself with wild animals it is extraordinarily shy and circumspect, thus adapting its behaviour to the example set by the particular mammal whose society it has adopted.

The honey-guide (*Indicator*), a bird, cries out whenever it sees a man or a ratel (*Mellivora*) ; if the newcomer will follow, it flies ahead in stages, and leads the way to a nest of wild bees. If, then, the man or the badger robs the nest, the honey-guide profits by eating the bee-brood. It is probable that originally the instinct was bound up with badgers only ; later the birds came to know that men, too, rob bee-hives, so that now, as a result of habit and tradition, they also set up their crying whenever they see a man. A further instance of symbiosis, where the movements of one species are guided by those of another, is furnished by sharks and their pilot-fishes. The pilot-fish guides the shark to any prey which it may have sighted, but does not itself attack the spoil, though it perhaps eats any stray morsel that comes its way. When in the company of a single shark the pilot-fish is well protected from enemies ; when several sharks swim together pilot-fishes are absent. Led by their following instinct, these fishes will accompany sailing boats, floating pieces of wood, casks, etc.

One animal will often use another as a guide in discovering sources of food. If ravens see a member of their own species dart downwards in a straight line they make for the same

spot ; this is also true of vultures, who sometimes, too, come to earth if they see a mass of ravens on the ground, since it is only on carrion that ravens crowd close together. Jackals will hasten at full gallop to the place where a vulture has alighted, expecting to find prey there (Berger, p. 125). According to Schillings, vultures in Africa sometimes guide the natives involuntarily to a place where a lion has made a kill, thus procuring them a meal. Gulls, too, follow one another, and also in the wake of ships, since experience has taught them that food is constantly to be found there. Frigate birds keep watch on dolphins and other fishes of prey, and when these drive a swarm of flying fishes above the surface of the water the frigate birds pounce upon the latter. Dragon flies keep pace exactly with horses, circling round them, not because they are particularly attached to these animals, but on account of the flies to be caught in their neighbourhood.

The call notes which some birds produce unceasingly, as well as those emitted by monkeys and beetles, have already been mentioned and recognized as a means of mutual understanding and as flock signals which serve to hold a company together. Tame cattle, similarly, pay heed to an artificial guiding sound, the bell belonging to their own herd. Among some of the mammals which live in herds a special smell belonging to the secretions of certain glands is the sign which keeps the herd together. In some species of birds white spots and stripes, visible perhaps only during flight, are the marks of identity by means of which two members of the same species recognize one another, just as among men signs of rank or numbers serve as

distinguishing marks upon uniforms, etc. In the same way the white patch which adorns the rump of many kinds of deer is regarded as an identification mark which enables an animal to follow its leader and its herd. The patch is conspicuous on roe-deer only during the winter ; this is said to be connected with the fact that in summer the females live alone with their young. When Japanese deer (*Pseudaxis sica*) are at rest, no patch is visible, but it becomes broad and clear when they take to flight.

According to Berger, wild animals without this white patch generally have tails strikingly light in colour on the underside, and their habit of wagging their tails when in flight is their method of displaying this guiding mark. According to Schillings, giraffes always lash their tails powerfully when in flight, or if their suspicions are aroused. He certainly goes too far when he asserts that although giraffes are completely dumb, these movements of their tails are "signals" by means of which they "convey their thoughts to one another" ; it is, however, perfectly imaginable that an animal whose suspicions have been aroused will set its companions on the alert by lashing its tail.

Among the higher vertebrates (birds and mammals) expressive movements are largely used as a means of mutual intelligence between one animal and another, and it is probably fair to suppose that such means take their origin, phylogenetically, in expressive sounds and movements.

According to Köhler, Pfungst, Brehm, and every competent authority, there is no species of ape in which the expression of emotion attains to the rank of an "ape-

language", as Garner erroneously imagined; even among chimpanzees, according to Köhler, no communication is ever made through any phonetic or other designation of objects. The alleged ape-language discovered by Garner was composed only of sounds expressing pleasure or displeasure; it is for this reason that it is possible to make an ape take promptly to its heels by reproducing a cry of fear on the gramophone; or, by reproducing a cry of hunger, to induce a corresponding state of excitement in the animal. According to Brehm the forms of expression in use among apes fall into distinct and different groups, which differ even among different species of the same genus; when members of these different species encounter one another in the common cage of a zoological garden, at first they either entirely fail to understand one another, or else, as very frequently happens, misunderstand one another to the point of open hostility. Only gradually do the different species make friends with their fellow-prisoners, and learn to interpret the sounds made by them. Each newcomer must first bite its way into a recognized position; this, according to Brehm, is a long-established phenomenon among captive animals, the result being that an exactly ordered social scale comes into existence, in which every individual has a perfectly definite rank (compare here Schjelderup-Ebbes' experiments in connexion with the "pecking-order" of a flock of fowls). Every ape species and every group of nearly related species has its own special noises, lip-signs, bodily deportment, and movements which it uses for intercourse. It would be of the greatest possible interest to establish how far these methods of communication are traditional, and how far they are based

upon instinct (using human beings as a comparison : a newly born infant sucks quite instinctively without any guidance ; the first attempts at speech are instinctive, but the traditions of the environment determine which language it learns). In the Berlin Zoological Gardens the way in which the apes conduct themselves towards each other has been designated for years as the "ape-code".

Pfungst declares that there was no authenticated case of weeping among the apes under his observation (compare against this what Rothmann and Teuber have to say of chimpanzees). Vocal expressions are richest and most numerous among the apes of the New World, and this is correlated with a certain poverty of gesture. Some of the motor manifestations agree in meaning and expression with those of men, e.g. the grinning of drills and mandrills ; Pfungst interprets this grinning as a playful display of their weapons, the eye-teeth, which occurs as they lift the corners of the mouth as a sign of goodwill ; and he comes to the conclusion that our assertion should not be of the form that "apes laugh, too", but that "men laugh, too, although they no longer bite". It seems to me, nevertheless, very doubtful whether the display of the eye-teeth (which are used as weapons), is the most important factor in the phylogenetic origin of laughter ; on the contrary, I believe that the eye-teeth in their quality of weapons played absolutely no part in originating laughter. Some gestures are identical in appearance with those of men, but possess an entirely different meaning ; thus, for instance, nodding the head is a sign of anger in baboons.

Since most of the gestures made by apes are completely

unlike those made by men, they have often been misinterpreted. No trace is to be found of that "sense of the comic" so frequently assigned to them. Grinding the teeth, chewing movements of the jaws, or opening the mouth widely all serve to display an ever-ready weapon, and thus denote rage. Baring clenched teeth, which being clenched are not prepared for fighting, is a sign of fear in many species. Pfungst believes that smacking the lips, with simultaneous movements of the tongue, originally expressed the foretaste of some toothsome morsel, and afterwards came to be a friendly gesture of greeting; it is also used to manifest a willingness to search through the coat of a companion, which, among apes, is an eagerly desired attention. In the course of this process, usually described as "louse-hunting", scurf, scraps of dirt, etc., are eaten, but not vermin, from which the animals, in captivity at least, are nearly always free.

Presenting the hindquarters is not, as has been imagined, either a threat, a sign of contempt, nor a defensive action, and even in the females it is not generally an invitation to copulate, but rather a mark of submissive friendliness and humility; the gesture is performed by young as well as by full-grown animals of both sexes, and they perform it before their own images in a mirror in just the same way. This greeting is only offered to their keepers in early days, and is abandoned as time goes on, possibly because the relation of dependence between them is fixed once for all, and perfectly well understood by both parties (Brehm). It would be of the greatest interest to establish how much of this ceremony, the "ape-greeting", is learnt, and how much is purely instinctive.

According to Rothmann and Teuber, the chimpanzee has at command an extraordinary variety of facial expression which includes that of mute laughter, weeping (without tears! but compare Köhler), joy, fear, rage, all the different grades of desire, disillusionment, jealousy, etc. This opens up the possibility of extensive communication between the animals. Expressive gestures of the arms are also highly developed among chimpanzees. Holding out the arms when the body is bowed and prone expresses a desire for pity or forgiveness. Ducking and presenting the hindquarters frequently signifies friendly submission; according to Rothmann and Teuber, the sexual origin of this gesture is often apparent. The animals were repeatedly noticed to touch each other with their mouths, kissing fashion; this always meant that a piece of chewed fruit was being passed from one animal's mouth into the mouth of a friend. The origin of human kisses most probably lies in this custom; among human beings, too, the passing of morsels of food from lip to lip is a form of erotic expression.

According to Pfungst wolves have ten different tones at their disposal; half of these are expressive of anger; if they are actually menaced, even young wolves kept in complete isolation set up a genuine baying. The view that they learn to do this by copying dogs, or that the baying is an imitation of the human voice, is thus rendered untenable. The domestic dog obviously barks more frequently because it is free from the restraints which force a wild animal to keep silence; thus barking, originally a method of expressing anger, becomes adapted to the utterance of other emotions, e.g. joy. Young male wolves have a habit of spontaneously

presenting the paw, which is expressive of a wish to make friendly advances. To show itself defenceless, a wolf rolls on to its back. To urinate frequently is a method of social intercourse. Among wolves and dogs scratching after defeacating is, according to Darwin, prompted by a rudiment of the instinct to cover over excrement; but Pfungst believes it due rather to an instinct to disseminate its own scent. The fact that some animals deposit their excrement on raised places, e.g. on stones, is held to support this view.

Under natural conditions, hamsters, badgers, martins, and rabbits void their excrement in special places. All species of lamas, and different species of antelopes, form heaps of excrement; and, in the case of guanos, when one of the heaps reaches a certain size another is begun near it. Hartebeests deposit their dung on a special circular area, trodden flat, in the middle of which stands a small ant-heap covered by stale dung. The levelling is brought about by a herd collecting on and near an ant-hill, turning the spot into a romping ground and trampling it flat. Berger has an illustration (p. 24) of one such deposit made by hartebeests. Schillings declares that the African rhinoceros (*Rhinoceros bicornis*) takes special pains to drop its dung in definite places, afterwards scattering it by scraping the ground with its hind legs. Schillings believes that the dung heaps serve as posts and guiding points by means of which the widely scattered animals can gather together again. A similar purpose is attributed to the action of the hippopotamus, which habitually scatters its dung over bushes with the help of its brush-like tail, covered with short stiff bristles.

A brief discussion of those animals which are supposed to communicate information by taps on the ground may be introduced at this point. It is not possible to take the accounts at present available into serious consideration, since, though very circumstantial, they are also quite uncritical. According to Guenther, something of great importance has never yet been seen to take place; appropriate action has not been observed to follow a communication grasped by the intellect. If one of these talking dogs is told "there is a cake for you in the next room. Go and fetch it," it does not do as it is commanded, but taps out some answer or other, its behaviour being thus directly contrary to that which dogs, as a rule, exhibit. Guenther's objection is certainly well worth consideration, but it is, nevertheless, always possible to object that here, once more, we may be faced by one of those riddles with which the mentality of men and of animals so often confront us.

Ants communicate by means of their "antennal language" (Escherich, p. 303, Eidmann). This "language" is no more than certain contacts of the antennæ serving to support the social instincts by communicating to one ant the emotions of another. Ants greatly desire this mutual contact through the antennæ, and if the need is left unsatisfied for any length of time they become deeply disturbed. It is used to excite the imitative instinct, as a summons to partake of food or to change the nest, to indicate that by following the guide food may be reached, to incite to attack or to flight, to give warning of danger, and to soothe excited companions; antennal taps are also used to indicate the path of a migration. The signs conveyed differ according to the

strength of the taps, their frequency and their location. Probably the odorous particles adhering to the antennæ (for prey, etc.) also play a certain part in communicating information. An ant lays emphasis on some communications by pushing its head against the breast of its companion. In a summons to food, the forelegs are made use of in addition to the antennæ, and the companion is licked in the region of the mouth. If warning alone has no effect, force is used to drag companions away from danger.

It has been noticed that when an ant discovers prey it taps another, and the latter betakes itself unaccompanied to the spoil, while the former departs to fetch further assistance. An alarm is rapidly spread from ant to ant throughout the nest by means of taps of the antennæ. Soldier ants also spread warning by knocking, or by special chirping noises. It has already been described how some guests of the ants are in a high degree adapted to life in an ant's nest. In this connexion it is worthy of especial note that the *Claviger* and *Lomechusa* beetles use their antennæ for tapping the ants just as the ants are accustomed to do in their communications with each other. These beetles touch the ants they encounter with their antennæ, cross them with those of the ants, tap the backs and sides of the latter, and stroke their cheeks if they want food.

Unfortunately we know much less about means of communication among termites than among ants; but the organized activity of the members of a termite state is a sure sign that termites also must have brought their methods of communication to a very high degree of development.

Among honey bees certain of the notes which they utter

have an extremely contagious effect, and result in the performance of some united action. Thus the characteristic swarming note issuing from one hive may induce another hive to swarm, although the time may not be ripe for it to do so. The stinging note given out by one bee will urge others to the attack, and the sting odour, i.e. the odour of the poison injected, has here a contributing effect. A queenless hive lifts up the mourning cry, and there are many other tones, e.g. the note of hunger, which inform an experienced bee-keeper of the state of affairs in the hive at any given moment.

Von Frisch has shown how honey bees communicate information to one another whilst engaged in the search for food. If a bee finds a particularly plentiful source of honey, on each return to the hive it executes a kind of round dance on the honey-comb ; this throws the bees clustering near it into a state of great excitement, and induces many of them to fly out in search of the source of the supply. If their loads are small, the homing bees refrain from dancing, and in this case their neighbours remain in the hive. Thus dancing is a method of informing the hive that a remunerative load is somewhere awaiting them. It is erroneous to suppose that a bee which has found a source of food escorts other members of the hive to the same locality. On the contrary the bees which fly out after the dance depart quite independently of the dancer, and search the country in all directions for the particular flower scent which clung to the dancing bee. This scent they have impressed on their memory by following the dancer about the hive and exploring the hinder part of its body with their organs of smell, the antennæ.

Another organ of communication is brought into use, especially in connexion with odourless sources of food. This is a pouch rich in glands, which, when it is extruded, gives out an odour perceptible even to men. The workers engaged in exploiting a rich source of supply, on arriving at their goal from the hive, circle round the former for some time with this organ extruded ; it is kept in this position while they suck the honey, and in this way the neighbourhood is impregnated with the peculiar odour which emanates from the organ. This serves to attract the new-comers from the hive as they fly hither and thither in search of the spot. The special sound given out by the wings of workers frequenting a rich source of supply plays no part in attracting new-comers. If, owing to weather conditions, the productive crop of nectar temporarily runs dry, the workers revisit the spot from time to time to inspect the process of its renewal.

The pollen gatherers communicate the whereabouts of a locality rich in pollen to one another, just as the nectar gatherers of the hive do in the case of nectar, by means of a dance. This dance, however, is a sort of "tail dance" rather than a "round dance", and in this case the special scent of the pollen brought in serves as a guide to the flowers from which it is obtained.

I PURE INSTINCT, HABIT, TRADITION

Many of the actions which in the case of human beings are determined by tradition ($C < V$), are regulated among animals by pure instinct ($C > V$) ; it is, nevertheless, necessary to point out that where animals are concerned we

are far from being able to declare in every case how much depends upon tradition, and how much upon pure instinct. In human beings tradition has to make good the comparative lack of instinctive certainty; hence the multiplicity of customs and opinions found among related and neighbouring tribes, and even among the different professions and classes of a single nation. The flexibility of human behaviour and the possibility of progress in the sense of an increase of knowledge are both dependent upon the fact that the majority of men's actions have to be learnt and practised, while a minority only are determined once and for all by instinct. Were it possible that among ants or spiders, as among men, some were learned (the reason this cannot be is that $C > V$), it is certain that these learned individuals would look upon themselves and the members of their own race as the key-stone of creation, assigning to men a comparatively low place in the order of creation on account of the very small number of specialized instincts possessed by them; for the criterion of high spiritual qualities, and the place to be assigned to those possessing them in a duly constituted society would naturally be, from the point of view of ants or spiders, the possession of instincts as highly specialized as possible.

The solitary spider builds its ingenious nest without pattern and without guidance; the process is, therefore, purely "intuitive". Among state-building instincts it is the unfailing certainty (so hard for us to imagine) of the instincts implanted in each individual which guarantees the continued existence of the community as a whole. But observations recently published by Wasmann and Rüschkamp indicate that among ants (in addition to instinct)

tradition and example may also play a part in fashioning behaviour. Wasmann showed that in a mixed colony workers of a certain species normally living underground behaved like the members of the species associated with them, and would go forth with them into bright sunshine to visit the leaf and scale insects. The innate instinct, in this case, was obviously modified on the one hand by direct imitation of the behaviour of companions, and on the other by means of the "antennæ language" with the help of which ants incite their companions of the same colony to share their own activities. Rüschkamp found the same sort of thing in the mixed colony under his observation; he further noticed that one of the two associated species infected by the example of the other not only took to rearing root-eating aphides instead of bark-eating aphides but even went so far as to make a complete change in their method of nest-building. The facts here related are of the greatest interest from the point of view of animal psychology, and it is very much to be hoped that ant investigators will in future also pay particular attention to any possible modifications of instinct.

It has already been shown that for young birds and mammals the instruction of their parents, or, at the least, the example set by them and by other members of the community, may be of great importance. Among those fishes, too, which tend their brood, the example of the parents may perhaps influence the manner of seeking for prey and avoiding danger. The fear of man is traditional and not purely instinctive in animals; for all travellers who penetrate to regions hitherto unexplored by man are unanimous in describing the animals inhabiting these

districts as altogether unafraid ; it is only gradually that they learn to flee their worst enemy, and the knowledge is handed down from generation to generation through the example of the older animals. According to Morgan, during the two years which followed the first erection of telegraph wires in Scotland, numberless white grouse flew into them and were destroyed ; later they learned, through tradition, to shun the danger. According to this author, too, the fear shown by birds and mammals at the sight of certain enemies is the result of experience and tradition. This fear is communicated by cries of warning which are themselves instinctive ; but the understanding of these cries is the result of experience and tradition. At first young birds and mammals instinctively react to any large object moving quickly ; with the growth of experience it is only the unaccustomed which evokes the reaction of fear. Cries of warning are likewise understood by animals of other species ; and these cries are also uttered by animals which have not themselves caught sight of the enemy, but have only heard the first alarm. Just as it is a tradition among some species to fly from men, others again seek their company ; it is through tradition that swallows and white storks have become the household companions of men, and nest only on human dwellings.

According to Morgan, newly hatched ostriches and Assam pheasants die of hunger if the breeder does not direct their attention to food by means of pecking movements. In the case of young pheasants belonging to other species, however, and young chickens, scratching and pecking is purely instinctive. Experience teaches them that to scratch among

loose earth is profitable, while scratching on hard ground is unprofitable ; and in a short time the chicks learn to distinguish in their pecking between edible and inedible objects. But it is always easier to rear young birds when they have old birds to imitate in eating and drinking, etc. Chicks in many instances also imitate each other. A breeder can teach young pigeons, separated from their parents, to pick up grain by putting them among young fowls, whose pecking they quickly imitate. A hen teaches her chicks to peck by taking up objects and letting them fall before their eyes. But even though a chicken will develop into an ordinary fowl without imitating the mother bird, its instinctive activities come into play earlier and with greater certainty when it has the opportunity of doing so. The same is true of other birds ; a bird will learn to fly without being taught by its parents, merely taking longer than it would otherwise do. In the case of ants, Heyde has established that if young ants are separated from their elders every activity, particularly nest-building and fighting, manifests itself later than is customary. Thus normally the actions of older animals incite imitation in those which are younger.

Coming into contact with members of their own species is an event of great importance for young dogs kept in isolation from birth ; they then come under the influence of traditional canine behaviour. Young beasts of prey reared in isolation would doubtless develop predatory methods similar to those of animals which had enjoyed the advantage of parental instruction ; but theirs would probably be found to lack polish. Tradition is of great importance to all those animals which live in herds. The individual, in these cases,

is born into a group of animals accustomed to perform a number of actions after a special fashion. With the help of the instinct of imitation it makes these ways and methods its own, and tradition hands these on from generation to generation. The dams built by Canadian and European beavers are said to be hundreds and thousands of years old ; thus countless generations have worked at them and taken pains to preserve them. In more densely populated countries, however, the beaver now usually inhabits simple subterranean burrows, and no longer builds itself a fort.

It may also be through tradition that the solitary honey-guide (*Indicator*) has acquired the habit of crying out not only when it sees a ratel but also when it sees a man. The Egyptian kite (*Milvus ægyptius*) makes an exact study of the habits of the human beings in its neighbourhood and awaits just the right moment in which to snatch its plunder. It attempts to profit in the same way from the hunting of other birds of prey, and follows hunters in the expectation of booty.

Young water birds swim purely instinctively and quite perfectly as soon as they emerge from the egg ; the American squirrel, captured in infancy and separated from its parents will hide away nuts in a room just as a wild squirrel hides them in a hollow tree, performing all the movements necessary for this action in the manner characteristic of the species. Wallace and others believed that birds build their nests solely by tradition and imitation. Nevertheless, it has been proved that birds which have never watched the building of a nest, nor inhabited one in their youth, will yet build after the manner of their species. It is, however, true

that old birds build more perfectly than young ones, so that practice is certainly of importance. In just the same way older harvest mice build their nests more skilfully than their younger companions.

It is debatable whether the nest-building habits of anthropoid apes are traditional or purely instinctive. Köhler believes the latter to be the case. And Brehm is of the same opinion concerning oranges. But it must be remembered that Köhler's chimpanzees were at least five years old when they reached Tenerife; thus they may very well have learnt to build nests beforehand in their free state or may at least have watched the process. According to Reichenow the nest-building instinct only makes its appearance in gorillas when these animals have lived under natural conditions up to a certain age, and not when they have been captured in infancy. It is, in addition, largely unknown how much of the behaviour of anthropoid apes should be regarded as traditional, and how much as purely instinctive. Consequently we are also ignorant whether, so far as their habits of life and expressive movements, etc., are concerned, differences are to be found between the different breeds of chimpanzees and other species, similar to those often found between nearly related and closely neighbouring races of men.

One of the most obscure riddles of animal psychology is the yearly migration of birds. Attempts have been made to prove that knowledge of the migrating routes is traditional. But this could only hold good for those species in which young and old travel together, e.g. swallows and storks. The explanation is worthless when applied to species whose members are divided into classes according to their age, and

in which the younger birds set out a few weeks before the older ones, e.g. starlings and crows. Ornithologists do not believe that the single older birds which take to flight at the same time as the younger ones serve as guides to the latter. Tradition seems to be altogether ruled out in the case of the species whose members, including the young birds, migrate alone, e.g. many birds of prey, certain species of singing birds, cuckoos, and hoopoes. The fact that even when birds are taken very young from the nest they are attacked by great restlessness at the migrating season seems to indicate that migration is instinctive. Experiments made with the help of rings have shown that certain individual birds, at least, return year after year to the same winter quarters, following always exactly the same route on their journey (Baldwin).

Cranes, herons, geese, ducks, swans, flamingoes, snipe, dotterels, all fly in V-formation ; one side of the V is usually longer than the other. If the flock is large a W is formed ; if it is small the birds often fly in a single slanting line. Young geese, still unable to fly, also form such a slanting graded line when swimming in the wake of their parents. The adoption of the arrow-head formation in flying is not traditional but purely instinctive, for it is characteristic of young wild geese which have been hatched out in captivity by domestic hens. The biological significance of the arrow-head formation is that for certain ærodynamic reasons it lightens the labour of flying for each individual bird ; the term " resonance flight " (*Resonanzflug*) is used in this connexion. The leader, who has the heaviest work to do, is frequently relieved ; the long side of the V is, as a rule,

turned in the direction from which the wind is blowing ; ibis, curlews and oyster-catchers fly in a long line, side by side ; starlings in large swarms with a wide front ; storks, larks, finches, yellow-hammers, thrushes, swallows and swifts in irregular flocks. The hooded crow flies in open formation, one bird after another.

In the songs of birds it is necessary to distinguish between inherited and acquired factors (Naumann, Haecker and others). The distinctive character of the notes emitted (fluting, whistling, twittering, power of modulation, rhythm) belongs to the innate endowment of each young bird and depends upon the structure of the vocal organs and inherited brain capacity. This inborn, purely instinctive song, however, is perfected, in each individual case, by instruction ; and this, in the young birds of any given species, depends entirely upon example, whether the example be that of the parent bird or of an unrelated stranger. This explains the well-known fact that chaffinches sing much worse in some districts than in others not far distant. Here, then, tradition plays an important part. It is a familiar fact to breeders of chaffinches and canaries that a good singer trains good pupils, but that good pupils are ruined by a bad singer. This is also true of nightingales. In districts where they are protected against marauders, of whatever kind, there are, naturally, many very old birds whose songs grow better and purer and stronger from year to year, and who thus provide instruction of progressive excellence for the young birds. In such districts the song of the nightingales undergoes a gradual improvement, whereas in places where the birds do not live to any great age the singing gradually

deteriorates (Naumann). If a young male nightingale is procured in autumn from a second brood it may be a source of the greatest disappointment, for it will never have heard an old male singing, and will be unable to sing well without this guidance.

The relation between the morphological structure of the vocal organs, the instinct to sing, and individual acquisitions, is most clearly displayed in the case of the so-called mocking birds, which weave into their natural song the notes of other birds as well as other sounds. Young birds brought up by foster parents belonging to another species may sometimes adopt the song of the latter. It is possible to train some birds (ravens, bullfinches, parrots) to repeat the sounds of human speech. The fact that birds belonging to the most dissimilar species are found in both these lists, is, according to Haecker, primarily an indication that the not inconsiderable variations in the vocal organs are of less importance to singing power than differences of mental endowment. Haecker maintains that the cases in which the female bird possesses a melodious song (canaries, robins, larks, bullfinches) can be fairly easily explained ; for, on the one hand, the female possesses, like the male, the necessary anatomical basis of song, and on the other, even the male has to acquire his real melody by a process of learning. Among birds, therefore, it is the varying development of mental capacity, and in particular of the instinct to sing, which lies at the root of the difference between the song of the male and the song of the female. The young of all, except mocking birds, instinctively choose one of their own species as a model. It therefore becomes clear that the necessary presupposition

of imitation is an instinctive, intuitive, primary, and consequently not acquired knowledge of the ideal best suited to the peculiar nature of each bird.

Young birds, accustomed from their earliest moments to the sight of their keeper, cling to him and follow him ; and it is afterwards difficult, if not impossible, to induce them to attach themselves to their parents. This is also true of mammals. Among sheep it is through experience alone that a lamb learns to recognize his own dam ; it is even possible for a lamb to fly in terror from its mother and follow almost any other large living creature. In order to overcome the mutual dislike of horses and donkeys, mule-breeders place young donkey foals, soon after their birth, with brood mares. In this way the donkey may become so completely accustomed to horses that when full-grown it cannot, by any means, be induced to pair with a female of its own species, and will only cover mares (Brehm, iii ; Aufl., vol. iii, p. 76). Thus, here, as in certain other instances, the " call of the blood " apparently fails to make itself heard. According to Whitman, if a pigeon is brought up by parents of another species it associates and pairs only with members of its adopted, and not with those of its own, race.

It is thus habit, and not an instinctive recognition of breed or species, which is the deciding factor (compare the national consciousness exhibited by human beings which has no necessary connexion with race). Among parrots kept in captivity love-making sometimes occurs between two birds of different species and the ties formed are not dissolved even if later one of the partners has the chance of pairing with a member of its own species.

Even parental instinct may be modified by habit. Morgan describes the behaviour of hens which have hatched out three successive broods of ducklings and thereby become accustomed to seeing the latter take to the water. When on the next occasion these hens were given hens' eggs to hatch out they made the most pressing attempts to induce the young chicks to take to the water, and even went so far as to push them in. It may here be pointed out that a hen which has already reared several broods of chickens is very much more disturbed when ducklings which she has hatched out make for water than a hen whose first brood behaves in this way.

J DOMESTICATION

Needless to say, a breeder cannot produce something entirely new ; he can only select from within the range of possible variations provided by his animals, and by breeding bring the desired quality to greater perfection. Through methodical crossing he may unite valuable characteristics in one stock ; he is further able so to improve the living conditions of his domesticated animals that the desired characteristics can attain their fullest development. Some tame animals have undergone such changes in the course of their domestication that if set free they would succumb ; others when freed regain the physique and mentality of their natural state, i.e. they become wild again. (Krieg has written papers which are well worth reading on the return to the savage state among men and animals as he has himself observed it in South America.)

The animals which man has domesticated are, chiefly, members of social species ; for animals living in herds are far more easily and completely tamed than those which lead a solitary life. Not every social species, however, lends itself to domestication. Man keeps tame animals because he is himself a social being. The tame animal and its keeper together form an organized society in which the man is the master, the animal the inferior (in Schjelderup-Ebbe's sense). The question of superiority is settled once for all. In this case the organized society holds together because the instinct of subordination in the inferior is correlated with the ruling instinct of the master. It is not utility alone which leads men to keep tame animals ; there is in addition the irrational element of his desire to command and to protect. Here, again, the social bond is stronger than the bond of race or species ; the dog protects its master against other dogs and is incited by him to attack other men.

According to Brehm, South American Indian women suckle apes, opossums and agoutis, along with their own children, and display the same tenderness of look and bearing for these animals. For it is the chief pride of these women to possess a large number of tame domesticated animals. Any young mammal they can capture they take to their own breasts and this leads to such affection on the part of these animals, of the apes in particular, that they follow her wherever she goes. All love for animals arises from a fostering instinct difficult to account for on purely rational grounds, and the animals concerned attach themselves with varying degrees of affection to their protectors from their natural desire for companionship ; they behave well

or badly according to the treatment meted out to them. Apes can sometimes be incited by their masters to attack men, fowls and other animals ; and, like dogs, they defend their masters. Jealousy is an emotion by no means unknown to many animals under human care ; a tame animal often greets its master with lively movements of its body and loud cries. Brehm describes a baboon which on being punished by its master never turned on the latter but always attacked anybody else who chanced to be near.

Man, and his subject animals, communicate with each other through sounds, glances, gestures, and touch. The understanding of these signs may demand a process of learning or it may come about spontaneously. There is no exaggeration in the oft-repeated assertion that man and dog understand one another by a glance, or that the ape, particularly the anthropoid ape, is so human in look and gesture that he can at once make himself understood by man. For men themselves do not always require words for mutual comprehension ; it is therefore quite conceivable that such comprehension should exist, within limits, between man and the creatures most like him, the anthropoids, or between man and that animal which is capable of attaching itself so affectionately to him, the dog.

Within the limits set by nature it is also possible to communicate with birds. Schjelderup-Ebbe describes the case of the grey parrot. When it wants food or caresses, this bird nestles up to its keeper, hops or dances along its perch, whistles a tune, and utters soft, pleasing, coaxing sounds. If it does not get what it wants it stamps and shrieks until it gains its desire.

Schulz gives an example of the great extent to which animals sometimes learn to understand their masters and respond to their intentions. He hunted zebras and antelopes on horseback in East Africa, and captured them with a lasso. The horse very quickly learns to recognize his rider's intentions, and itself becomes so filled with the excitement of the chase that it occasionally bites the captured zebra. Some antelopes, when hunted, will make a sharp turn in their flight ; the horse of its own accord immediately makes the same turn. Dogs are reported to display similar traits during the chase.

One purpose among others for which dogs are employed in consequence of their versatility is that of guarding live-stock. In this task they behave at each moment as the situation demands : they treat lambs much more gently than sheep. It must here be mentioned that domesticated cranes will shepherd flocks of birds and four-legged beasts exactly like dogs, without having been trained to do so. And a captive agami can lead and keep together a flock of domesticated fowls.

Those species have become domesticated animals, in the strict sense of the word, which are of some definite use to their keeper. As I have said man is unable to create anything that is strictly new by the art of breeding ; he can but transmit variants particularly suited to his purposes from one generation to another by means of appropriate selection and rejection. But since nothing absolutely new can be charmed into existence it is all the more necessary that the breeder should keep his eyes open for novel and favourable morphological, physiological and psychological variants.

Pfungst declares that dogs derive from wolves and jackals, not from foxes, and proves that here, too, domestication has brought nothing new into being. Thus he noticed that the rudiments of retrieving show themselves in the play of entirely untrained young wolves.

By consistent selection man has brought some animals to the point of behaving almost as automata under his hand, so that of their own accord they may exert themselves to the utmost in their work. Any peculiarities of behaviour which are the result of training have to be learnt afresh by each generation of animals (hunting hawks, sporting dogs, the *haute école* in the case of horses) ; it is therefore only the ability to learn and not what is learned that is inherited. Many domesticated animals, through their association with men, have entirely lost their original sociological organization into mateships, families, or societies; it is in consequence largely inadmissible to draw conclusions about the behaviour of animals in general from the behaviour of domesticated animals.

It is only races and species capable of adaptation which have been domesticated by man, e.g. horses and asses ; zebras, on the other hand, are hard to tame ; for exhibition purposes it is necessary to place them with ponies which then act as " instructors ". Indian elephants, captured full grown, become friendly with man within a few weeks and do the work demanded of them willingly ; the African elephant, on the other hand, is much less adaptable.

" Domesticated animals " are also to be found in ant and termite states. But it is characteristic of these " domesticated animals " that among themselves they are

unsocial or live at the most in loose associations. They either provide their keepers with nutriment in which case they may be called true "cattle", or they produce a luxury only, namely their exudations, and are then called *symphilæ*. These latter, together with certain species which serve as "cattle", are in every respect so completely adapted to their parasitical mode of life that without their hosts they perish ; conversely some ants are entirely dependent upon being nourished by certain kinds of lice.

X HUMAN SOCIOLOGY FROM A BIOLOGICAL STANDPOINT

No matter how we choose to approach the question of the origin of man, this much must be taken as certain, namely that from an anatomical and physiological point of view he belongs to the animal kingdom. Palæontology teaches us that in earlier days men existed of a lower morphological type than the men of to-day ; and history shows that man has progressed at least in the sense of attaining more complete knowledge. It is a familiar quarrel whether the difference between the mentality of man and the mentality of animals is one of genus or merely of degree. But the difference between the point of view from which each side appraises the mental characteristics of men and animals is too great to permit the bringing about of any rapid reconciliation between the two divergent opinions. In the course of this essay there have been many instances of characteristics common to both men and animals ; instances which make it possible on the ground of psychological data to rank the two together. Nevertheless, it must not be forgotten that men possess certain mental qualities possessed by no animal, and this fact indicates a difference between the two which, in some respects, is fundamental.

The most prominent feature of the greater number of human actions is that the variable factor, V, more or less

completely outweighs the purely instinctive constant factor, C (*vide* introduction). As instances of actions in which the instinctive factor preponderates, we may quote sucking in a newly born infant and the sexual act. But in every action, even those which at first sight appear purely intellectual, C and V are indissolubly united. Some things which in men are governed by tradition ($V > C$) depend in animals upon instinct alone ($C > V$); thus in men tradition has to fill the gap left by the lack of instinctive certainty. The fact that among men the formula is almost always $V > C$, and that V as a rule largely preponderates, explains why in human societies, schools, courts of justice, parliaments, etc., can exist, but not why they actually do exist. Among the state-building insects, where C on the contrary has so disproportionate a superiority, such institutions cannot occur. From its earliest moments the newly hatched insect has at its disposal all the "knowledge" necessary for life. Man has almost everything to learn by experience, but he inherits the power to collect experience, and inheritance determines the range of possible experiences. For man the "norm" is, then, that nearly all his activities require to be practised, whereas for insects the "norm" is that almost without exception no practice is required for the performance of any activity.

Every species, including the human species, has assigned to it a definite morphological, physiological and psychological scope beyond whose limits it cannot go. Individual variations are possible only within this fixed scope, the origin of which I shall not now discuss. "Arbitrary actions" which transcend the limits set for the species never

occur ; every peculiarity of behaviour rests upon a definite physiological and psychological basis. It is, in consequence, altogether erroneous to suppose that human institutions, such as the state, religion, marriage, etc., are purely arbitrary products somewhere and at some time by chance devised by a ruler or a ruling group for their own ease or their own advantage. Were this so, were these institutions not founded upon the inner life of man as a whole, with all its instincts and impulses, they would long ago have disappeared like a passing craze of fashion, and fallen into oblivion. That they have always maintained themselves continuously, even though changing in outward vesture, is the best proof of their natural origin. For men would never arrive at understanding each other even in the simplest matters if the idea to be understood did not rest upon some common universal foundation.

It would be an interesting, though for plain reasons an altogether impossible, experiment to arrange for a number of children to grow up in a state of complete savagery in order to find out what social organizations man is capable of creating without the help of tradition. The outcome of this experiment would naturally vary according to the individuals concerned in it. But it is certain that such isolated human beings would create a community of some kind, and equally mateships and families, in addition to a religion and some form of language ; artistic activities and certain ceremonies would be found among them, festivals would be celebrated, traditional dances would be invented, and so forth. They would pursue theoretical and practical knowledge in some guise or form, however barbarous their chosen methods or

procedure might appear to us. (It may, nevertheless, be hinted that possibly our own collective modern wisdom might appear in no better light to some "sovereign spirit".)

Not every author recognizes with sufficient clearness how firmly all the behaviour of men and animals is rooted in instinct. Thus Whitman denies that those pigeons which form monogamous mateships (and among which occasional infidelities occur) possess a special "instinct of fidelity"; he argues that we cannot speak of "ethical ideals" in connexion with pigeons, and that the birds hold together only because no opportunity for unfaithfulness occurs. Nevertheless, to this it must be opposed that no lasting social organization—were it merely a colony of brooding pigeons—could possibly be built up on such haphazard foundations. The *sine qua non* of every social organization is that the individuals comprising it shall instinctively react in an appropriate manner to the given milieu, shall adjust themselves to given circumstances. Less essential things may then come to the support of this indispensable factor, e.g. respect for the beaks of other mated pigeons, the claims of nest-building, the necessity for tending the young, etc. Did there not exist in pigeons a certain instinct for monogamy there would still be time for them, in the midst of all their occupations, to indulge in promiscuity.

If we seek to understand clearly the origin of the "ethical ideals" of human beings, we are forced to recognize that they depend upon the whole system of instincts and impulses which man possesses solely in virtue of his being a social creature. Although the outward vesture of these ideals may change from race to race and from time to time, nothing they

contain has at any time been arbitrarily contrived by any man ; they may be explained by the roundabout ways of reason, but their source lies in the irrational. If man were an asocial animal it is probable that ethical ideals would not exist at all or would be limited to the relations between male and female and their offspring ; most of the ideals would be purely egoistic.

Among both men and animals a profound conservatism secures the continued existence of an organized society, namely the impulse to maintain what has once become traditional. By this means the social organization, once created, remains in being ; rebellions and riots are invariably followed by some form of social existence. Social beings will always evolve some kind of society ; and this, both among men and many animals, is a graded hierarchy in which one or more individuals assume the part of leader ; the instinct to rule in the superiors is correlated with an instinct of subordination in their inferiors.

Pfungst, Köhler and others point out that in apes the range of interest is never entirely restricted to the immediate necessities of life. The same cause accounts for the irrational, instinctive, insatiable thirst for knowledge in man. This thirst is imperfectly expressed by the proverb "*non scholæ sed vitæ discimus*". For in the main we seek knowledge neither for school nor life, but because the "daimon" within us compels us to do so. It was not by accident that this proverb was in everyone's mouth, in the age of rationalism. The desire for knowledge in man has its counterpart in a desire to teach and communicate knowledge, of which the root is only to a very minor degree to be found in the

pleasure to be derived from a sense of superiority. The desire to teach and the desire to learn are the presuppositions of any comprehensive tradition ; and this, in turn, gives rise to a body of knowledge which increases from generation to generation. Tradition among men has above all this advantage over tradition among animals, namely that it has a cumulative effect, in which speech and technical expedients play a most important part. In my opinion the greatest discovery of the nineteenth century was that of man's unbounded technical inventiveness.

The development of tradition involved, among human beings, a far more intensive cultivation of relations between those united by ties of blood, than is found among animals, where the family frequently disintegrates as soon as the young are full-grown ; and we have no sign that full-grown animals feel themselves more closely bound to one another in virtue of a common ancestry.

The curiosity and energy of captive anthropoid apes are seen to be squandered in purely playful activities. Yet the instincts concerned are exactly similar to those which, more precisely adjusted, underlie the gradual progress made by man in the direction of civilization and culture. If the anthropoid apes landed themselves in an evolutionary blind alley, one of the main reasons was their inability of their own accord to direct their superfluous energies. We find that, in general, the more nearly animals are related to us the closer the resemblance between their instincts and our own, whether these instincts be egoistic, altruistic, or of other kinds. The egoistic instincts, in particular, have a way of appearing less undisguised among men ; but for all that

human motives are often fundamentally quite as gross as those of any other mammal, only a whole arsenal of abstract ideas is employed to deck them out in a more pleasing garb.

The playful activities of apes contradict the "law of parsimony" so dear to natural science, according to which every species is endowed only with the abilities and characteristics which are absolutely necessary in the struggle for existence. If we try to apply this principle to the case of man, it becomes clear that his whole existence is one continued refutation of "the law of parsimony"; and we are forced to recognize that side by side with such a principle, if indeed it exists at all, a "principle of extravagance" must also reign not only in the case of men but throughout all animate nature. Phylogenesis in its progress may sometimes make use of the latter principle.

Racial evolution must not be regarded as conditioned by external and fortuitous environmental factors alone; internal factors are always, probably more so than any other, of decisive importance; yet, of these factors, whether they be internal or external, we know absolutely nothing. For instance, it was not merely the fact that the ancestors of man had hands that occasioned the development of man; for in that case why are not all apes men? It is an error to regard the cause of phylogenetic development as so superficial; probably in all cases it goes much deeper.

Man is a creature living in societies. It is most likely that these societies were originally always organized, closed communities. As they develop, societies tend to become less exclusive, and, like the states and large cities of the present

day, acquire in some respects precisely the character of associations. It is a commonplace that a man may live most alone in a great town. Thus for some individuals a large city is nothing more than an association in a milieu they themselves have created. (Compare what is said above of the *Paramœcium*.) But since man is a social animal, in every association links are usually at once fashioned between its component individuals who thus become united into societies interrelated in many ways.

I mentioned in my preface that it is idle to ask whether "in nature" the society or the family is the older type of companionship. This much may be said: comparing solitary with social life the former is the lower form; herd life exists only among the highest animals. Mateship and the family on the one hand, and herd life on the other, rest upon two totally different instincts; these two forms may co-exist in one and the same species, as when mateships and families are formed within the herd, or they may mutually exclude one another, as when a herd each year divides up into monogamous or polygynous mateships at the beginning of the breeding season. Among men, as among many animals, the instinct for conjugal and family companionship and the herd instinct appear together, and there is no reason to suppose that among primitive men the case was different. Until there is proof to the contrary we may assume, then, that the hordes of the latter, together with those of his progenitors, always consisted of a number of single mateships and families. The existence of human speech is in itself evidence that primitive man was a social being. All the theories of primitive man living in a state

of idyllic promiscuity gain no support from anything hitherto discovered. If promiscuity, in one form or another, has at any time occurred, it has always been merely as an accessory phenomenon ; closely knit mateships and families have always been (and are to-day) the twin supporters and preservers of the race as a whole and the many individual races.

Men do not possess what earlier authors called "innate ideas". There is instead a pre-formed basis, C, for ideas, but these only come later. An innate idea of God, gods, and spirits does not exist ; but men of all races possess the impulse, derived from C, to indulge in metaphysical speculations ; the particular form these shall take in any individual is always left to V. There are no innate ideas of particular things (a horse, a tree, etc.) ; their formation during individual development is the work of V ; but the general capacity for conceptual thinking pre-exists in C. But perhaps the instinctive activities of insects are analogous to what in human beings would be called the manifestation of an "innate idea".

The possibility of religion was given when man began to form ideas on the one hand about his dependence upon his environment, and on the other about the demands made by his own egoistic and social instincts. He objectified the demands of "the inner voice" into gods and goddesses more or less spiritually conceived. A rich growth of imaginative theories entwined themselves around these, and satisfied his need of metaphysical speculation.

Animals also obey an "inner voice", and "have no choice" when they sacrifice themselves to the rearing of

their young or some other social activity. In itself it would certainly be "pleasanter" for the bird to eat, to sun itself, etc., than to build a nest and rear a brood; but the "inner voice" enjoins the latter. The animal is guided by its instincts, and does not ponder over them. Man, in virtue of the preponderance of V, is forced to make himself clear as to the moral demands of his inner nature. He recognizes the moral order fixed for himself and enlarges it into a moral ordering of the universe; every race does so in its own way. If the different species of animals were gifted, as men are, with a propensity for speculation each would construct a world order cut to its own pattern, and every one of these world orders would be valid and "real" within the circle of individuals for which it was created.

BIBLIOGRAPHY

- ALLESCH, G. J. v.: *Bericht über die drei ersten Lebensmonate eines Schimpansen* (Sitz.-Ber. Akad. Wiss. Berlin), 1921.
- ALVERDES, F.: *Über Reflexe, Instinkt- und Verstandestätigkeiten* (Zool. Anz., Bd. 80), 1924.
- *Über vergleichende Soziologie* (Zeitschr. f. Völkerpsychol. u. Soziol., Bd. 1), 1925.
- BALDWIN, S. P.: *Adventures in Bird Banding in 1921* (The Auk), 1922.
- BALSS, H.: *Über Anpassungen und Symbiose der Paguriden* (Zeitschr. f. Morphol. u. Ökol., Bd. 1), 1924.
- BERGER, A.: *In Afrikas Wildkammern als Forscher und Jäger*. 2nd ed. Berlin, 1922.
- *Über Brunft- und Setzzeit in den Tropen* (Wild u. Hund., 28. Jahrg.), 1922.
- BREHMS: *Tierleben*, Bd. 1-13. 4th ed. by v. O. zur Strassen. Leipzig and Vienna, 1912-8.
- BUCHNER, P.: *Tier und Pflanze in intrazellulärer Symbiose*. Berlin, 1921.
- BUTTEL-REEPEN, H. v.: *Die stammesgeschichtliche Entstehung des Bienenstaates*. Leipzig, 1903.
- *Das Leben und Wesen der Bienen*. Braunschweig, 1915.
- DARWIN, Ch.: *Die Abstammung des Menschen*. Übers. v. J. V. Carus. 2nd ed. Stuttgart, 1899.
- DEEG, J.: *Über Brunft- und Setzzeit in den Tropen* (Wild und Hund., 28. Jahrg.), 1922.
- DEGENER, P.: *Die Formen der Vergesellschaftung im Tierreiche*. Berlin, 1918.
- *Soziologische Studien an Raupen und Bemerkungen über Licht- und statischen Sinn* (Arch. f. Naturgesch. 86. Jahrg. Abt. A.), 1920.
- *Soziologische Beobachtungen an Hyponomeuta cognatellus Hb.* (Biol. Zentralbl., Bd. 42), 1922.
- DÖFLEIN, F.: *Das Tier als Glied des Naturganzen*—in R. Hesse and F. Döflein, *Tierbau und Tierleben*, Bd. 2. Leipzig and Berlin, 1914.
- EIDMANN, H.: *Das Mitteilungsvermögen der Ameisen* (Naturwissensch. Jahrg. 13), 1925.
- ESCHERICH, K.: *Die Termiten oder weissen Ameisen*. Leipzig, 1909.
- *Die Ameise*. 2nd ed. Braunschweig, 1917.

- ESPINAS, A.: *Die tierischen Gesellschaften*. Übers. v. W. Schloesser. Braunschweig, 1879.
- FOREL, A.: *Le monde social des fourmis*. 5 vols. Geneva, 1921-3.
- FRIESE, H.: *Die europäischen Bienen (Apidae)*. Berlin and Leipzig, 1923.
- FRISCH, K. v.: *Beitrag zur Kenntnis sozialer Instinkte bei solidären Bienen* (Biol. Zentralbl., vol. 38), 1918.
- *Über die "Sprache" der Bienen* (Zool. Jahrb., Abt. Allg., vol. 40), 1923.
- GARTKE, H.: *Die Vogelwarte Helgoland*. Braunschweig, 1891.
- GARNER, R. L.: *Die Sprache der Affen*. Übers. v. W. Marshall. Leipzig, 1900.
- GEYR v. SCHWEPPEBURG, H.: *Zur Sexualethologie der Stockente* (Journ. f. Ornithol., Bd. 72), 1924.
- GIRTANNER, A.: *Aus dem Leben des Alpen-Murmeltiers (Arctomys marmotta L.)*. (Zool. Garten, 44. Jahrg.), 1903.
- GOETSCH, W.: *Die Abhängigkeit sozialer Insekten vom Nest* (Sitz-Ber. Ges. Morphol. u. Physiol.). Münschen. Jahrg. 34, 1923.
- GUENTHER, K.: *Über die "denkenden Tiere"* (Zool. Anz., vol. 52), 1921.
- HAECKER, V.: *Der Gesang der Vögel*. Jena, 1900.
- HEYDE, K.: *Die Entwicklung der psychischen Fähigkeiten bei Ameisen und ihr Verhalten bei abgeänderten biologischen Bedingungen* (Biol. Zentralbl., vol. 44), 1924.
- HUDSON, W. H.: *The Naturalist in La Plata*. 3rd ed. London, 1895.
- JACOBI, A.: *Mimikry und verwandte Erscheinungen*. Braunschweig, 1913.
- JENNINGS, H. S.: *Das Verhalten der niederen Organismen*. Übers. v. E. Mangold. Leipzig, 1910.
- JORDAN, H.: *Vergleichende Physiologie wirbelloser Tiere*, vol. 1. Jena, 1913.
- KATZ, D.: *Tierpsychologie und Soziologie des Menschen* (Zeitschr. f. Psychol., vol. 88), 1922.
- und TOLL, A.: *Die Messung von Charakter- und Begabungsunterschieden bei Tieren (Versuche mit Hühnern)* (Zeitschr. f. Psychol. und Physiol., Abt. 1, vol. 93), 1923.
- KOEHLER, W.: *Intelligenzprüfungen an Anthropoiden* (I. Abhandl. Akad. Wiss. Berlin: Phys.-Math. Kl.), 1917.
- *Zur Psychologie des Schimpansen* (Psychol. Forsch., vol. 1), 1921.
- English trans. of the former *sub tit.* "The Mentality of Apes", containing the latter—"The Psychology of Chimpanzees" as an Appendix. Kegan Paul & Co. Second (revised) ed., 1927.
- KORSCHULT, E.: *Lebensdauer, Altern, und Tod*. 3rd ed. Jena, 1924.

- KRIEG, H. : *Studien über Verwilderung bei Tieren und Menschen in Südamerika* (Arch. f. Rassen- u. Gesellschaftsbiol., vol. 16), 1925.
- KROPOTKIN, P. : *Gegenseitige Hilfe in der Tier- und Menschenwelt*. Übers. v. G. Landauer. Leipzig, 1908.
- LUCANUS, F. v. : *Die Rätsel des Vogelzuges*. Langensalza, 1922.
- MEISENHEIMER, J. : *Geschlecht und Geschlechter im Tierreiche*, vol. i. Jena, 1921.
- MORGAN, C. L. : *Instinkt und Gewohnheit*. Übers. v. M. Semon, Leipzig and Berlin, 1909.
- MÜLLER-LYER, F. : *Formen der Ehe, der Familie, und der Verwandtschaft*. München, 1911.
- *Die Familie*. München, 1912.
- MURPHY, R. C. : *The Most Valuable Bird in the World* (Nation. Geogr. Mag., vol. 46), 1924.
- NAUMANN'S *Naturgeschichte der Vögel Mitteleuropas*. Herausg. v. C. Hennicke, vols. i-xii. Gera, 1905.
- OERTZEN, J. v. : *In Wildnis und Gefangenschaft*. Berlin, 1913.
- PECKHAM, G. und E. : *Instinkt und Gewohnheiten der solitären Wespen*. Übers. v. W. Schoenichen. Berlin, 1904.
- PFUNGST, O. : *Zur Psychologie der Affen*. Bericht 5. Kongr. f. exper. Psychol. 1912.
- *Versuche und Beobachtungen an jungen Wölfen*. Bericht 6. Kongr. f. exper. Psychol. 1914.
- REICHENOW, E. : *Biologische Beobachtungen an Gorilla und Schimpanse* (Sitz.-Ber. Ges. Naturforsch. Freunde, Jahrg. 1920). Berlin.
- RENSCH, B. : *Zur Entstehung der Mimikry der Kuckuckseier* (Journ. f. Ornith., vol. 72), 1924.
- ROTHMANN, M. und TEUBER, E. : *Aus der Anthropoidenstation auf Teneriffa I.* (Abhandl. Akad. Wiss. : Phys.-Math. Kl.). Berlin, 1915.
- RÜSCHKAMP, F. : *Instinktmifikationen in einer Ameisen-Adoptionskolonie* (Zeitschr. f. wiss. Insektenbiol., vol. 19), 1924.
- SCHILLINGS, C. G. : *Mit Blitzlicht und Büchse*. Leipzig, 1905.
- *Der Zauber des Elelescho*. Leipzig, 1906.
- SCHJELDERUP-EBBE, Th. : *Beiträge zur Sozialpsychologie des Haushuhns* (Zeitschr. f. Psychol., vol. 88), 1922.
- *Das Leben der Wildente in der Zeit der Paarung* (Psychol. Forsch., vol. 3), 1923.
- *Der Graupapagei in der Gefangenschaft* (Psychol. Forsch., vol. 3), 1923.
- SCHMID, B. : *Von den Aufgaben der Tierpsychologie* (Abhandl. z. theoret. Biol., H. 8), 1921.

- SCHROTTKY, C. : *Soziale Gewohnheiten bei solitären Insekten* (Zeitschr. f. wiss. Insektenbiol., vol. 17), 1922.
- SCHULZ, C. : *Auf Grosstierfang für Hagenbeck*. 3rd ed. Dresden, 1922.
- SCHUSTER, L. : *Brunst- und Saisonzeit des Wildes in den Tropen* (Wild u. Hund., 29. Jahrg.), 1923.
- SOKOLOWSKY, A. : *Zur Frage des Geisteslebens der Menschenaffen* (Med. Klinik, Jahrg. 5), 1909.
- STRESEMANN, E. : *Über gemischte Vogelschwärme* (Verhandl. d. Ornithol. Ges. Bayern, vol. 13), 1917.
- THURNWALD, R. : *Psychologie des primitiven Menschen*—in G. Kafka, *Handbuch. d. vgl. Psychologie*, Bd. I, Abt. 2, 1922.
- *Zur Kritik der Gesellschaftsbiologie* (Arch. f. Sozialwiss., vol. 52), 1924.
- VOLL, W. : *Im Dämmer des Rimba*. Breslau, 1921.
- WASMANN, E. : *Die psychischen Fähigkeiten der Ameisen*. 2nd ed. 1909.
- *Die Gastpflege der Ameisen* (Abhandl. z. theoret. Biol., H. 3), 1920.
- *Eine interessante Instinktregulation bei Ameisen (Lasius mixtus Nyl.)* (Atti R. Acc. Lincei Rend. Roma. 76), 1923.
- *Die Ameisenmimikry* (Abhandl. z. theoret. Biol., H. 19), 1925.
- WHEELER, W. M. : *Ants*. New York, 1910.
- *Social Life among the Insects*. New York, 1924.
- WHITMAN, Ch. : *The Behavior of Pigeons*. Ed. by H. A. Carr. Carnegie Inst. Washington. Publ. 257. Vol. 3. 1919.
- YERKES, R. M. : *The Instincts, Habits, and Reactions of the Frog* (Psychol. Review. Monograph. Suppl., vol. 4). 1903.
- *The Mental Life of Monkeys and Apes* (Behavior Monographs, vol. 3), 1916.
- ZIEGLER, H. E. : *Tierstaaten und Tiergesellschaften* (Handwörterbuch d. Naturwiss., vol. 9), 1913.
- *Die Urformen der Ehe und des Eigentums* (Mitt. d. Ges. f. Tierpsych., N.F. Nr. 5), 1924.

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The Psychology of Animals

The Psychology of Animals

IN RELATION TO HUMAN PSYCHOLOGY

BY

F. ALVERDES

Professor of Zoology, University of Marburg
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INTRODUCTION

THE man of science is not infrequently accused of devoting too much attention to details, and so losing sight of broad generalities in a maze of single facts. It is sometimes said that the learned have neither the power, nor even the desire, to make the subjects they have chosen for their life-work accessible to a wider public. Often enough, it is maintained, these subjects are not suitable to such popularization, since they are too remote and specialized.

We shall not here consider to what extent such reproaches are justified. But we may at least remember that exceptions exist. In the following pages I offer my own attempt at a short description of such parts of animal psychology as are of interest to a wider public, at the same time exhibiting the many and various relations existing between human and animal psychology. Animal Psychology is a branch of science which has already developed a complicated technical vocabulary—of necessity, since without it the observations could not be properly described, and a common understanding between individual workers would be impossible. In the present connection I shall, however, avoid as far as possible the use of technical terms. And as in the case of many other branches of research, a person not acquainted with animal psychology would regard many lines of investigation as entirely beside the point and superfluous, if he heard of them

apart from their connections. Only these connections give to an apparently trifling detail its meaning and importance.

It is not my intention to add one more to the existing full accounts of animal psychology. My wish is rather to describe in popular language such parts of the subject as appear to me to be of most importance today ; and at the same time I hope, by setting out from a more general biological point of view, to be able to give some new suggestions regarding human psychology. The purpose of the book led of itself to the necessity for avoiding too many details, and confining myself to the selection of those points most interesting to a general audience.

[Systematic names of organisms are italicised only on their first appearance, in the belief that the general reader will find this more agreeable than the persistence in italics usual in English scientific works.—H.S.H.]

The Psychology of Animals

In Relation to Human Psychology

CHAPTER I

Difference between living and non-living nature —The "End" (aim, object, purpose, goal) and the "Whole" as biological fictions—"The End determines the Means", and "the Whole determines the Parts".

OF all the branches of learning which make up the science of zoology, that of Animal Psychology appears to me personally to be the highest. Anyone who has worked through all the various departments of zoology, through the study of various animal forms, through morphology, embryology, theory of descent, comparative physiology, and all the rest of the many branches, should, I think, find at last in Animal Psychology the most important teaching of all, and one of particular value as regards a deeper view of man and his place in Nature. My object in this book is to introduce the reader to the chief problems of Animal Psychology—or more cautiously speaking, those problems which appear to me personally as outstanding, and of most immediate interest.

Since this book is addressed to the lay reader, no special knowledge of the subject will be assumed, and only matters of general interest will be selected for discussion.

By way of introduction, it is necessary to deal with

some preliminary questions which may seem to the reader rather remote from the subject. The first of these is the general question of the nature of life.

Life is bound up with matter, but we are unable to say what it really is. We can only state what are the properties which characterize living organisms, and how these creatures differ from non-living nature. We are then confronted with the problem of what agency maintains all the phenomena of life in continued activity.

Most readers will have heard of the battle between *Mechanism* and *Vitalism*, at least as far as the terms themselves go. Mechanism proposes to explain life phenomena as the interaction of highly complicated physico-chemical processes, which take place in the substances constituting the organism. Vitalism, on the other hand, assumes that matter alone can never give rise to the phenomena of life, but that an immaterial agent must be present, which has power over non-living matter; this agent is supposed to interfere with, and regulate continuously, the chemical and physical processes, in order that a living organism may come into being and continue to exist. Generally speaking, this agent is regarded as more or less analogous with the conscious human psyche. In my opinion, this conflict between mechanism and vitalism is fundamentally impossible to settle. It is beyond the powers of our human mind to decide whether life processes take place solely in accordance with physico-chemical laws, or whether a special agent is behind them and controls them. In this matter, therefore, we must be modest: and in this case—as also in others—it is better to recognize clearly the

limits of our knowledge and insight, than to conceal our ignorance under mere words.

If we consider non-living nature, we see that it is in a state of balance or equilibrium : and when a disturbance occurs, the corresponding restoration of equilibrium takes place at once. The same is true of the single living being ; normally, the various functions of its body are in harmony with itself and with the external world, and when this harmony is upset, a new state of balance is soon set up. But there is a fundamental difference between the processes which lead to a balance on the one hand in the non-living, and on the other in the living world : in the latter, they ensure the preservation of the living organism *as such*, its continuation as an individual, as a whole complete in all its parts. They are such as to ensure both its persistence and its integrity. There is nothing of this kind in non-living nature ; the heavenly bodies, the continents, mountain ranges, masses of rock, rivers, are never organisms akin to living things, and hence are not capable of self-regulation, as are the latter.

We will here introduce a fiction. We say that the insurance of persistence and integrity is the " biological purpose " of the regulatory processes taking place in the organism. But when we make use of this idea, we must be perfectly clear that we are dealing with something which we are putting into nature. Experience has taught us for example, that when one organ is lost, another can function so as to compensate for the loss ; if a human being loses one kidney the other enlarges and thus is able to do alone the work which was originally done by the two. In this and similar cases, we assume that it is the

purpose, object, or aim of the processes we observe to secure the organism against death and dissolution, to maintain it as a complete whole, as an individual. In non-living events, on the other hand, we are never able to discover such a meaning or aim; we must therefore say that these processes are apart from all aim or meaning, not aimless or meaningless, since this can only be said in cases where the meaningful also exists.

I would like at this point to meet an objection which can perhaps be made against the notion of an imaginary purpose in the biological sense. I said before, and repeat here, that we deduce this purpose from experience. When in a large number of cases and in given circumstances the same result is always obtained when, for example, we cut one leg off each of 100 newts and the loss is made good in all cases, we regard the reconstitution of the complete animal as the aim and object of the processes of growth which take place. We are dealing in statistics, so to speak, and they teach us in this instance, that in 100 per cent of cases of a certain operation, to wit the cutting off of a leg, the same effect occurs, namely, that it grows again. It may now be said that in inorganic nature also, statistics lead to the same result; that like causes produce like effects. We might, for example, allow 100 balls to roll down a hill, and all of them would come to rest at the same spot in the valley. Are we then, it may be asked, to describe this spot as the "aim" or "object" of the balls? To say the least, this would be to weaken very greatly the idea of purpose which we have just set up.

The difference becomes plain when we vary the con-

ditions of the experiments which we make on living and non-living objects. Thus we may carry out our experiments on the newts by treating each one of them differently as regards the way we cut the leg, never completely removing it, but leaving in every case more or less of it; here again the result of the process of regeneration is the restoration of a complete leg. Or we may cut a fresh-water polyp (*Hydra*) or a worm into numerous pieces; every single piece replaces what is missing, and so becomes a complete animal. In the latter case it is noteworthy that every single part is different from every other, not only, it may be, as regards size, but above all because each part is derived from a different part of the original body. All of them, therefore, must attain their aim of the restoration of the complete animal by different means. This leads us to an important law which holds for biological processes: "the end determines the means".

But may not this law perhaps be applied to the processes taking place in the inorganic world? Let us return to our 100 balls, which we will again allow to roll downhill. But we will now no longer choose the old path, but allow one ball to roll down at one point, another at another, with the result that none reaches the original goal. This is a proof that in the first experiment with the balls, though all of them reached the same place, this place was not the aim or object of the balls, in the biological sense.

Obviously, our law that "the end determines the means" is nothing more than a fiction; it has merely to describe relationships which we recognize as such.

We will now consider how widely this law holds. Does it hold only for the processes of regeneration which we have been considering? Let us observe a series of representatives of various species of animals, as regards their behaviour when endeavouring to reach a certain object, a source of attraction. A bird, for example, towards which we throw a piece of food, may hasten to it by flying or running, or even by a mixture of the two; and if we are dealing with a water-bird, a third possibility exists, namely swimming. The three modes of locomotion which we have named, running, flying, swimming, depend upon entirely different kinds of muscular activity; and if flying is combined with running or swimming, we have again something quite different from running or swimming alone. The birds are thus able to approach the food in all kinds of ways, they make use of various "means"; but what the bird actually does is determined by the single fact, that it is striving to reach its aim. The same is true of a winged insect, to which we offer a source of light in a darkened room, it may approach it running or flying. In the same way, a water insect, which we observe in an aquarium, may strive to reach a certain goal either by running on the bottom, or swimming.

The majority of animals run in the direction of the long axis of their bodies, but an animal is able, on occasion, to move sideways or at right angles, if its ends are served thereby. Here also the means are varied in accordance with the end. In the case of certain crustacea, for example the common crab (*Carcinus*) or the hermit crab (*Eupagurus*) we see, by way of contrast to other animals, that move-

ment in the direction of the body axis is rarer; they more frequently move sideways or diagonally, and move more rapidly thus. What is important in this connection is this: in the course of a single journey undertaken by the animal for the purpose of reaching a certain goal, it may continually change the direction in which its body points with reference to its path from straight ahead to any angle to right or left, without the straightness of the path being influenced in any way. But every time that a new orientation is assumed, the muscles of the legs have to act somewhat differently; here again it is the "end" which determines the "means" chosen.

Let us consider our own walking, or that of any animal, such as a beetle. If a man or a beetle commences to take a step, the goal of the movement thus begun is the completion of the step. And according to the nature of the external situation as it is met with, that is, according to the nature of the ground, the means used to attain this end are varied. This end is not, of course, assumed to be a "consciously grasped objective", but simply the object which we regard as determining a biological movement which we observe. (We shall deal with the problem of consciousness in the next chapter.)

Higher animals, apes for example, are capable of attaining an end by roundabout ways. We attach to the roof of a large cage a fruit of some kind. The chimpanzee, for example, is able to make use of various possibilities for gaining possession of the fruit. He may run to the wall of the cage, and climb up it and along the roof, and so reach the fruit. If the roof offers no holds to enable him to traverse it, he may fetch a stick and strike at

the fruit until it falls down. W. Koehler and Bierens de Haan have further shown that apes will fetch boxes and pile them one upon the other, in order so to reach the fruit. Each of the various actions we have described may be further subdivided into parts. We then see that running to the side of the cage, or to fetch a stick or boxes, are actions which in themselves do not bring the apes nearer to the object, but rather first of all take them away from it. Regarded simply, these actions appear meaningless, and only the serial arrangement of the actions in accordance with the situation gives sense to the resulting total action. We are thus presented with the possibility of varying our fictional rule concerning the end and the means as follows: "the whole determines the parts".

We may then perform an experiment by making it impossible for an experimental animal to use its ordinary means of progression: in the case of animals possessing a considerable number of limbs, we may, for example, amputate several. Take the common crab (*Carcinus*), which possesses eight legs. We can remove from our experimental crabs a number of these legs wholly or partially and in various combinations, but the animals always retain the power, even in extreme cases of disablement, of making straight for a desired point.

Let us consider a highly complicated activity of a quite special kind, the construction of its web by the spider. Every species constructs a special form of web characteristic of it, but in the single cases the external conditions are never exactly similar; for the animal may at one time spin its web in a four-cornered hole in a wall, for

example, at another between two beams meeting at right-angles, at another between two bushes, and so on. In each case it is necessary to attach the first threads in a different manner ; but what then appears is always the style of web peculiar to the species. Here again, therefore, it is the end that determines the means, and the whole that determines the parts. If we injure such a web not too seriously, the spider very soon repairs the damage. This process also fits in with our fictional rules.

In my remarks concerning our fiction of the aim or end of biological action, I started from regeneration ; I then extended the notion to various actions and activities of animals. It can now be shown to hold for the whole of biological happening. A further example will illustrate this. When we study in the case of an animal the embryonic and larval development up to the reproductive stage, we are confronted with a series of what are often quite different stages. We then may introduce the fiction : the adult individual is the end, the various stages of development are the means : or we may also state the matter thus : the total development is the " whole ", the single stages are the " parts ". K. E. von Baer, over a hundred years ago, compared the development of the individual with a melody. In the latter, as we know, the sounds are not strung together anyhow ; a relation exists between the first and the last note, in such a way that not merely does the first influence the last, but also the last the first. The whole melody is the end, the various notes are the means ; or the melody is the whole, the notes are the parts.

However, what is the nature of a melody ? Is it perhaps

something that belongs to non-living nature? If the latter were the case, would it not lead to the conclusion that many phenomena in inorganic nature are similar to embryonic development? Now, a melody is not an "inorganic event", but is produced by its creator—a living human being—on the basis of a conception of the whole which he forms, and which is the occasion of this melody arising in his mind; it is reproduced from time to time by other living creatures, the performers; it only exists at all when a living creature, a human being, creates it and recreates it.

CHAPTER II

General remarks on scientific statement, and more concerning the fictional mode of regarding biological facts—Consciousness, freedom of will, psyche

IN the last chapter we started from the difference between living and non-living natural bodies. I said that it was fundamentally impossible to decide whether the course of life processes results only from chemical and physical phenomena, or whether there is behind them a special non-material, psyche-like agent. In order to make the difference between the living and the non-living particularly clear, I introduced some fictions, which were to be applied only to biology. I spoke of the wholeness of the individual, of the maintenance of a whole as the end and object of biological processes; this end is attained by living creatures by means which differ from case to case. We finally arrived at the following two rules; "the end determines the means" and "the whole determines the parts". In the application of these two fictional sentences to biological events, we see the much debated "self-rule of life".

It is possible that the whole way in which I have presented and expressed the matter has aroused your strong opposition. You are perhaps of the opinion that the scientist—and therefore also the biologist—should deal only with what is really given, whereas I have repeatedly spoken to you of fiction. For this reason it

would be well for us to come to an understanding concerning the nature of scientific investigation and of the description of scientific observation. Such a description can only take place by that being emphasized which appears important to the observer. Accordingly, experience teaches us that in matters of daily life two observers may find quite different things of importance, and hence give two completely different descriptions of the same event. Even one and the same person may take a completely different view of identical events, according to his experience just previous to their observation. Regarded in this way, the tendency, for example, towards mechanistic or vitalistic viewpoint is chiefly a question of personal necessity determined from within, in one's inmost heart one desires the world to be constituted thus or thus, and seizes upon the necessary "proofs" to form a foundation for one's view. And if in the case of a given person the nature of his world-view changes in course of time, those "proofs" which had hitherto been rejected will suddenly appear important, and "directly convincing".

But what quite generally is the way in which our conscious ego places itself in relationship with the external world? It is our sense organs alone which are the means of this contact. All that we observe goes through the filter of our sense organs, and what cannot pass through these does not "exist" for us at all. The data received by our sense organs are conveyed to our central nervous system. This may be from time to time in very different conditions. For we are not even the same from one moment to the next. In other words, the sense data which we receive may meet from case to case a central

nervous system of quite different character, and prepared in quite a different way, and hence they may be made use of in quite a different manner. But the mosaic of sense data will always be worked up in our "thinking organ" into whole perceptions; what is mirrored there is in the form of whole pictures, and it is from this complete picture that we derive the abstractions and fictions that we need to comprehend and reproduce the external event with which we have been in contact. Let us be clear about the matter: we never come directly into contact with external things "as they really are". For what is there in us that "really knows", and is able to get into direct contact with "the things outside"?

In view of the constitution of our human thinking apparatus, there is no other means left to us than that of working with whole abstractions. The fact that concepts such as "the animal", "the insect", are pure abstractions, everyone will agree, but even when I describe a particular individual beetle as "this beetle" I thereby make a statement concerning a wholeness relationship grasped by me as such; for the expression "this beetle" is already an abstraction, derived from the simultaneous observation of a large number of details of this animal's body. When I say "this beetle is running", this is correspondingly the integrated sum of a large number of single processes.

Our manner of thus grasping wholes is unconnected with our voluntary and conscious intention; it cannot be rationally explained as regards its origin, its nature, and its laws; it is for us something primarily given. We are only in a position to determine by observation

and experiment the statistical rules according to which it takes place.

This immediately raises the question as to how far life altogether is rational, that is to say, capable of being comprehended by our intellect. We will proceed to extend at once the problem thus raised, by linking it with the question as to what extent not only life, but also the whole of natural events, are capable of being rationally understood. I will state shortly where the limits lie, or rather, where they appear to me to lie. We have already seen that "knowledge" depends much less upon the object to be known than upon the subject which knows it. Hence it is a matter of the mental structure of the observer, whether he emphasizes and regards as important what is comprehensible by the intellect, or what is irrational, in life and in world events generally. If we attempt to account to ourselves concerning the origin of life, or of the world itself, and how it happens that everything is just as it is, and is happening as it is and not otherwise, there remains for us nothing to do but to admit "we do not know and we never shall know". For everything connected with these questions is irrational. People of course exist for whom the facts of life and of the world appear self-evident, and who are entirely insensitive to the problematical nature of the world and life. Whoever is willing to limit himself in this way, and feels completely satisfied when he has discovered the laws according to which observed events take place, may well arrive at the view that the world can be explained purely rationally. As opposed to this, we may express our own view by the following image :

all that is possible for us is to determine, as regards the course of the world, the rules of the game, so to speak ; but the origin of the game itself and of its rules, to keep the metaphor, is completely beyond our knowledge. I regard it as necessary to emphasize this, since even at the present time, natural science is continually called upon as chief witness to testify in favour of the purely mechanistic world view. An historical " explanation ", that is to say, an " explanation " from what has happened hitherto, is merely an apparent explanation ; for even if we are able to state in what way anything has become what it is and as we see it today, this tells us nothing whatever concerning its origin, and for what reason it has become what it is. We may therefore say that it is waste of time to search for the origin of life ; and the question of the " meaning " or " object " of life becomes—at any rate in the light of our present point of view—a merely apparent problem, for meaning and object were only fictions for us. As the fictional end of numerous life phenomena at least, we assumed the maintenance of a whole—but this whole itself was only a fiction. Of course, not each and every biological process is to be regarded as having for its object the maintenance of a whole ; for there are others which have the opposite effect, for example all which lead to disease and death. And along with these, there may well be many which are indifferent as regards the whole. Furthermore, we also find in organisms, processes and body parts which in so far point beyond the individual being, as they allow us to conceive an imagined whole transcending the individual. These are the processes and organs which

are connected with reproduction, with the care of offspring, and with other relationships to the species as a whole ; and we may then sometimes find it useful to regard the species as a fictional whole, and to speak of the maintenance of the species as the fictional aim of the processes of reproduction. To go beyond the species with a further fiction of super-individual wholes appears to me inadvisable ; I at any rate cannot see what would be gained in our present connection by the fiction of an aim for the whole of life or for the world. Let there be no misunderstanding ; there is no intention whatever here of judging, let alone condemning, those guiding ideas which pedagogics or ethics give to individual persons or to the whole of humanity concerning the meaning and aim of life. In that case the meaning and aim—as I hope to have already made clear—are ideas of value, and hence of entirely different nature from those dealt with here. (For further discussion of the idea of the whole transcending the individual see the seventh and tenth chapters.)

We have already frequently spoken of the human consciousness. It is now time that we should consider this in more detail. Concerning the nature of it, everybody is informed without further explanation ; but what the consciousness depends on, and what the meaning of it is, is completely beyond our powers of investigation. We do not know whether in our case it takes an independent part in the processes of our psychical functions. When we make a decision, when we “ will ” something, it is impossible to decide whether our consciousness produces this act of will out of itself, or whether the act

proceeds, in the sense of the mechanistic point of view, as a result of the physiology of the brain, the consciousness being then nothing more than an accompaniment, an "epiphenomenon".

This brings us to the problem of the freedom of the will. Here again we are dealing with a question fundamentally incapable of decision. For one person, his own freedom of will is directly evident, the other finds it equally obvious that freedom in the common sense—that is, indetermina-tion—is absurd, but that everything must result simply from the physico-chemical processes which form the basis of the physiology of the brain. Both of these views are incapable of proof ; whoever adopts one or the other must be clear about the fact that he is only following the needs of his own individual world attitude, and "laws of logic" which he has created for himself.

Theoretical knowledge that the question of the freedom of the will is insoluble, cannot prevent us from ascribing to the fiction of freedom an important function in social life.

In teaching, criminal law, etc., we cannot do without this fiction ; for it is a very important determining factor in guiding the single individual in a direction desired by human society.

Hence it is impossible for us to decide how human consciousness comes into being ; furthermore, we do not know whether such a thing as freedom of will really exists ; and finally, the question whether an immaterial human psyche also exists or not must remain open. We can only make use of the psyche as a fiction ; we may perhaps be permitted to make use of it as an image.

We set up the fiction that behind the life functions of the single organism there stands an immaterial, soul-like agent. Whatever happens in the body is supposed to be under its control, for example, digestion, secretion, breathing, regulation of heat, etc. ; and finally, also the functions of the central nervous system. The latter is again divided into stages of lower and higher centres, the highest layer, in the case of man, being the cortex ; the activity of the latter is connected with the phenomenon of consciousness. We make the further fiction that the psyche-like agent possesses, in the form of this uppermost region of the central nervous system, an instrument, with the help of which it becomes conscious of itself, whereas otherwise it remains hidden and unrecognized by itself. This would make the conscious human psyche the narrow region of the psyche-like agent upon which the spotlight of self-consciousness is able to fall. But do not forget that what I have just put forward is an image, a fiction and nothing more ; in these regions it is impossible to prove anything, all that one can do is to attempt to make that which cannot be directly seen and investigated more or less intelligible by means of comparisons. We are therefore not by any means assuming a contrast between the conscious and the unconscious (or subconscious) in ourselves, as is not uncommonly done. Instead, consciousness shall be for us the continuous prolongation of the unconscious out of darkness into light.

What is now to be said concerning the consciousness of animals ? Here it must be emphasized most decidedly that this again is an insoluble problem. For we do not even know concerning our fellow human beings, anything

about the nature of their consciousness and its content. We can only conclude that it is much the same as, or more or less similar, to our own. To take the simplest example, there is no possibility of deciding whether another person experiences the sense of red in exactly the same way as I do. In cases where defective colour vision or even complete colour blindness exists, it is only possible to prove the opposite. The same is true for all other contents of consciousness. In the case of animals, we are quite unable to come to any decision at all; we can only regard it as more or less probable that in their case also something of the kind exists. On the basis of behaviour similar to that of a human being, it may be more or less clear to us that a dog, for example, experiences joy or pain. No proof of this can be given, and the further a species of animals is removed in its organization from our own, the more strange to us is its whole behaviour, and the less are we in a position to feel sympathetically the processes of its consciousness.

The question of animal consciousness must therefore be excluded from animal psychology. Not because it is not interesting, but because it is insoluble. When in these lectures we speak of the purpose of animal behaviour, we therefore can never mean purpose consciously conceived in the animal's psyche, but only a biological end imagined by the observer. In many cases it will follow naturally that this fiction coincides with the conception of purpose in daily life, for example, when any animal makes directly for an object in an unmistakable manner. But the part played by this object in the animal's consciousness, supposing it to be

present, cannot be determined. The psyche-like agent which we have imagined as standing behind life processes is, of course, not regarded as "all powerful" and infallible; it may also "make mistakes". We have already spoken of processes tending to the destruction of the whole, which occur in disease. Furthermore, in regeneration processes all kinds of malformations occur from time to time, for example, in the case of newts, the legs may grow too large or too small a number of toes, or limbs may be doubled. Nor does every kind of injury of the organism from outside find suitable regulation; in many cases therefore, the removal of bodily parts may lead to lifelong injury or early death. Correspondingly, an organism may also make mistakes as regards its locomotive behaviour towards an external stimulus, particularly when we produce a defect in its sense organs. If for example, we blind an insect on one side, we thus delude it with an apparent darkness on that side, and the result is that when making towards the light it will sometimes not make for it directly, but turn off in arcs and spirals towards its seeing side.

Nevertheless, the animal body always behaves as a whole, even when the functions are not adapted to the situation, as in the case of defective operation in regeneration, and in erroneous locomotion. Operation as a whole, and adaptation to the situation, are therefore two different notions. To take an example from human life: in the case of a child that is learning to walk, the body operates as a whole, but not in a manner perfectly adequate to the situation. As the most important result of what has been said in this chapter, I should like to emphasize

the following : when we set up the fiction that a psyche-like agent is behind the life function of the individual organism, and creates its character of wholeness, the human psyche will be no more than a part of this which has become conscious of itself. In this way, the contrast between the bodily and psychical functions becomes relative. In the case of animals, we know nothing of a psyche conscious of itself. Nevertheless, the treatment of the subject which we have chosen enables us to deal with all life phenomena in animals—metabolism, growth, regeneration, locomotion, and so on, under a single point of view.

CHAPTER III

Individuality—the ciliated slipper-animalcule (*Paramecium*) as individual

WE will commence our survey with the concept of individuality. The literal meaning of "individual" is that which is indivisible. In the case of man and the higher animals indivisibility is largely a fact. It may first be said that we experience ourselves subjectively at every moment as an indivisible unity. Certain parts of the body, for example, arms or legs, can be removed from man or higher animals, without his life being directly endangered thereby; but the part cut off perishes. Such an operation, therefore, does not give us two parts each capable of separate life. And if we were to attempt to cut one of the higher organisms into two parts of approximately equal size, we should be met with complete failure, inasmuch as both halves would then immediately perish. However, by suitable treatment it is possible to maintain alive for a considerable time parts separated from the bodies of the higher and even the highest animals. The isolated heart, for example, of a frog or other vertebrate continues to beat if we supply it with a suitable salt solution in place of blood. Success has also been obtained in removing parts of the bodies of higher vertebrates—for example chicken embryos, and cultivating them further in artificial media. In this way, it is possible to maintain for a long period cultures of

connective tissue, muscle-cells, epithelia, gland cells, and so on, and even to cause them to multiply greatly. Nevertheless, the characteristic structure of the organs in question, which would otherwise be built up by these cells, is lost, and the cells themselves may change their nature very greatly. They grow into nothing more than an irregular mass of cells. All the same, we are obliged to conclude that even the highest organism is not indivisible in the strictest sense, since it is possible to grow single parts of its structure in a suitable culture medium ; this method is called " explantation ".

As regards the lower animals, in many cases there can be no question of indivisibility. Many protozoa can be cut up in various ways ; the parts remain alive and regenerate themselves to complete animals ; it is, however, necessary that each such part should contain some nuclear tissue. In the case of an amoeba having a single nucleus, only that part continues to live which contains the nucleus ; amoebæ which have many nuclei regenerate from all parts which contain at least one nucleus. In the case of *Stentor* (one of the ciliates, so called from its trumpet-like form), the nucleus is shaped like a chain of pearls ; if we cut such an animal into several parts, all those regenerate which contain a portion of the nucleus. As regards lower multi-cellular animals, for example a freshwater polyp (*Hydra*) or many worms, we have already said that they can be cut up into very many parts, and that each part is capable of developing into a complete animal. By natural means also, two or more animals may arise out of one ; the multiplication of protozoa takes place by means of such cell-division. In many

classes of multi-cellular animals, we find, along with sexual reproduction, reproduction by budding, in which one animal forms as a bud on another, from which it finally separates itself. If this complete independence is not reached, that is, if the individuals formed as buds remain physically connected with the parents, we have the formation of "colonies", where in extreme cases the single individual actually becomes some special organ of the colony, and the colony itself then takes the rank of an individual. As regards plants, everyone knows that a large number of species are mainly propagated by cuttings.

The opposite process to the division of individuality into two or more parts is the artificial union of two parts derived from different animals to form a single whole. Graftings of this kind have been successful in the case of the multi-nuclear amœba *Pelomyxa*, and of *Hydra*, earthworms, and amphibia spores, etc. The part played by grafting in gardening needs no emphasis.

Individuality in biology cannot therefore be defined as indivisibility. Individuality can rather only be regarded as the functioning with reference to a whole of those parts of an organism which are connected together in a normal manner. All functions are to be included, thus metabolism, growth, bodily movement and locomotion, etc. If the normal connection between the various regions of the body is destroyed, the wholeness of the functions is correspondingly vitiated.

So far we have not only considered the reactions of animals as regards movement, but also all other possible phenomena of life, such as metabolism, growth, repro-

duction, and regeneration. This was done to show that bodily movement and locomotion do not occupy a special position as regards the animal's performance, but that all its life processes may be regarded from a single point of view. But from now on attention will be mainly directed to the particular theme of this book, the science of the behaviour of animals. We will begin with the protozoa, and test by means of several examples whether the fictions we have set up of wholeness and relation to the whole, etc., are applicable to the behaviour of these unicellular creatures.

We will only deal shortly with the amœba. It is generally visible to the naked eye, and crawls about the bottom under water by stretching out foot-like appendages (pseudopods) in one direction and drawing them in in the other. This means of locomotion only gives the impression of complete irregularity when considered quite superficially. It can only be understood as a function of the whole; for if the motion of the pseudopods were not always concerted, every amœba would very soon tear itself into a number of small parts. The amœba, also, always reacts as a whole whenever it meets on its way a stimulus which causes it to change its direction. A chemical stimulus, one of heat or touch, or sudden illumination, will all serve this purpose. The amœba is therefore not merely a lump of protoplasm, without definite form, but more than that: an individual in the sense of our definition.

We will now treat at greater length another example from the protozoa, the *Paramecium*. This belongs to the class of ciliates, and is completely covered with

several thousand fine hairs (cilia), which are able to move rapidly. The animal, which, like the amoeba, consists only of a single cell, has a length of about one-hundredth of an inch, and is therefore just visible to the naked eye. Its body is approximately cigar-shaped; we are able to distinguish a back and a belly. In the latter we find the mouth, which is prolonged to form a cavity which receives the particles of nourishment supplied to the cell body. The mouth lies at the end of the mouth-region, which begins on the left side of the front end of the body, and passes diagonally backwards as a flat depression. The presence of this depression leads to the Paramecium bearing a distant resemblance to a slipper, hence the name slipper-animalcule. The mouth region makes the cell body slightly asymmetrical.

The animal's locomotive apparatus is the covering of cilia. The cilia are planted in the surface of the body and each springs from a swelling or root, the "basal granule." Not only in the case of Paramecium, but in the case of other animals, these two structures, the cilium and its basal granule, are described as the cilium element, and when we isolate such an element, it is able to move on its own account for a short time, until it finally perishes. If, on the other hand, we separate the cilium from its root, it immediately comes to rest. There is an important difference between the beat of the single cilium element when isolated and when situated in its normal position on the body. The motion of the isolated cilium is invariable or stereotyped; the only change that one observes is that it first moves at a furious speed, then gradually tires, and finally comes to rest. As opposed

to this stereotyped motion of an isolated element we have the motion of the cilia on an intact *Paramecium* ; sometimes they beat quickly, sometimes more slowly and sometimes they stand still. Obviously something is present which regulates the activity of the individual ciliæ.

When we observe an uninjured *Paramecium* under the microscope, we can make another important observation regarding its hairy coat ; the movements of the single cilia do not happen independently of one another. There is always a connection between them, such that those standing behind one another, in the direction of the stroke, swing in turn one after another (metachronously), whereas those which are alongside one another swing together (synchronously). This process gives much the same impression as we get from a field of corn over which gusts of wind are blowing, and causing the corn to move in waves.

The *Paramecium* either remains at rest, or moves according to the number of its cilia which beat, and according to the strength with which they do so. We see a picture which continually changes ; at one moment the animal is still, and attaches itself by means of a number of its cilia, which are then held rigid, to some object. Only the cilia around the mouth are then in motion, bringing particles of food to the animal ; but this process may be helped by a larger or smaller number of the other hairs co-operating. Then most of the cilia, or all of them, may suddenly begin to work very actively, and the animal swims away.

The forward motion of the *Paramecium*, like that of

the other ciliates, is, in free water, a rotatory. The animal thus moves screw-fashion, that is, in a spiral, the front part describing a larger circle than the other end. The animal turns, as seen from the front, clockwise. Its back is always directed outwards, and its belly towards the axis of its rotation. Let us suppose that an individual which we are observing meets in the course of swimming with some stimulus, for example, some chemical dissolved in the water. The animal then has a number of different possibilities by which it can avoid the irritant. It may carry out a searching movement, stopping for a moment and moving its fore-part in a circle, the whole body thus moving round the surface of an imaginary cone; after this, the animal may set off in another direction. Or the animal avoids the dissolved substance by going around it in a curve, and returning to its old surroundings. It can carry out its avoiding movement still more quickly by suddenly turning aside, or even completely round. If the stimulus is very strong, the Paramecium may move backwards for a space, rotating as in the case of its forward motion, and in the same direction. It will then change over to swimming forwards in another direction.

These by no means exhaust all the ways in which the paramecium may move. It may also travel forwards without rotation, as it frequently does when moving over a surface. And when it moves in a medium which has been thickened, for example, by quince-mucilage, it no longer turns clockwise, but in the opposite direction. The biological meaning of this change in its rotation is by no means clear.

All these different ways of moving forward are effected by the activity of the cilia. If the animal is moving forwards and rotating clockwise, the cilia work correspondingly in a sideway direction, or that is to say, if we are looking at the animal, they move to the right and backwards, if it is moving forwards without rotating, they all beat together forwards and backwards. If the animal is moving backwards and rotating, the cilia have to move sideways and forwards, and when it is moving forwards in a thick medium and rotating in the opposite direction, the cilia have to move to the left and backwards. We can convince ourselves by observing the animal under the microscope that it moves forward as a whole in a manner corresponding to the way in which the cilia are working. In the more complicated types of motion however, as described above—the searching movement around a cone, the swimming in a curve and the sudden turn from a stimulus—it is impossible to observe accurately how the cilia move.

But whether we are able to observe the direction of beat in detail or not, one thing is certain: in all cases the whole of the cilia—and this means, as I have said, many thousands of single hairs—move in strict co-ordination; single cilia never work independently of the others, as they do when separated from the body. But how is this co-ordination brought about? In higher animals and man we have, in the central nervous system, a clearly distinguishable centre which takes care of the activity of the locomotive organs, for example the legs. A special centre of this kind is wanting in the bodies of protozoa, and nevertheless we observe the strictly co-

ordinated working of the many thousand locomotive elements, the cilia.

We can come to no other conclusion than that, in the case of the protozoa, the whole cell acts as its own central organ for control of locomotion ; according to this view, it depends upon the whole condition of the *Paramecium* cell at any time, which of the cilia beat, and which remain at rest. Single cilia, or any particular collection of them, never answer independently to any stimulus from outside. Such a stimulus is first transmitted to the whole cell, and this decides whether, and how, and by what cilia, the stimulus is to be met. The single cilium is only able on its own account to produce a purely stereotyped beat ; according to the situation, the whole condition of the cell protoplasm checks, releases, or otherwise regulates the motion of the single hairs, and thus turns their individual activities into a total activity regulated as a whole.

When natural cell division commences, a constriction is formed in the middle of the body of the *Paramecium*, which at first does not prevent the activity of the hairs from being in unison. But as the circular depression becomes deeper and deeper, a moment comes when the individuality originally existing begins to separate into two. This moment is apparent to the observer by the fact that differences appear in the activity of the cilia of the two animals—the fore and hind parts. Finally, the two twins are only connected by a fine thread of protoplasm ; but the co-ordination in beat between the fore part and the hind part is then already at an end ; one may be at rest, while the other sets its cilia working,

the former being dragged forward for a little by the latter, until it itself begins to swim actively. Or both may have their cilia working actively, and pull one another to and fro, until finally the connecting thread breaks and we have two entirely independent individuals.

Division of this kind can be imitated artificially. By means of a fine thread of glass we can cut a *Paramecium* into two halves, the fore part and the hind part; both parts then swim away in different directions. All relation between them has ceased to exist; each half-animal exhibits, as regards the activity of its cilia, unity of action. In forward motion, therefore, both halves rotate clockwise; after a stimulus, for example, by touch, they move, rotating in the same sense, backwards a short distance. If we thicken the medium by means of gum, both the fore-animal and the hind-animal rotate counter-clockwise. In all these cases we see that, as in the case of an intact individual, the whole coating of hairs works in unison in corresponding direction. The isolated half-animals are also able to come to rest for a time, whereupon the cilia are stationary. The fact that the two half-animals usually perish in a short time, about one half to one hour, has no importance in this connection. This fact depends mainly upon the size of the wound. But in any case, and at the very best, only one half would be capable of survival, since only one half can be in possession of the nucleus. It is, by the way, of importance that the motion of the cilia in the two halves takes place without reference to the presence or absence of nuclear substance; the nucleus is therefore not responsible for the production of ciliary motion and its various modifications.

The experiment of artificially dividing the *Paramecium* into two individuals can be varied by not completely cutting the animal in half, but merely compressing it strongly in the middle of its body by means of the glass thread. If by this means we succeed in abolishing the granular structure of the protoplasm at this point, the front and hind halves each operate on their own account, and give separate impulses to the cilia attached to them. Harmony then only exists as a secondary matter, when, for example, one half drives the whole body forward by active motion of the cilia, the other half usually takes up the same activity; but this is in no way the result of the conduction of an impulse along the protoplasm, but obviously is caused by a purely mechanical stimulus, due to the half in question being pulled passively through the water. And at any moment the co-operation may come to an end by one of the halves changing the character of its ciliary motion.

If we observe an animal thus crushed in the middle for a somewhat longer time, we see that the structure of the protoplasm reappears in about half an hour at the point of injury. This depends upon the fact that the protoplasm flows together in front and back halves, and in the same degree as this takes place co-ordination between the fore part and the hind part is renewed, so that at the end of the process we have again to deal with an individual which acts with complete unity. Our interference therefore divided the individuality of the *Paramecium* into two parts; but after a short time these two were again united and became one.

What has been said above concerning the *Paramecium*

evidently holds in principle for all ciliates, and indeed for all protozoa. According to their bodily organization, their modes of reaction and behaviour of course differ ; but we are always dealing with living creatures which, exactly like the higher animals, take rank as organisms possessed of an individuality. While, therefore, an unbridgeable gap separates living from non-living nature, the differences between various living creatures appear to be of a more gradual description.

We may deal shortly with some other ciliates. *Stentor*, which we have already mentioned, is more complicated in structure than *Paramecium*. It possesses two kinds of cilia ; one a general coat of hairs covering the body uniformly, and the second a spiral of cilia which surrounds the mouth at the fore part of the body. This spiral consists of little bundles of cilia arranged one behind the other, and these, when the animal takes hold anywhere with its hinder part, waft particles of nourishment to its mouth. When the animal lets go, they assist the other cilia to produce locomotion. A peculiarity of *Stentor* is the possession of muscular fibres running lengthwise along the body, and enabling the animal to contract with lightning rapidity, when stimulated. The statement made by earlier writers, that *Stentor* also possesses nerve threads, has not been confirmed.

Stentor swims with a clockwise rotation ; if it meets an obstacle, it is, like *Paramecium*, able to avoid this in many different ways. It may continue to rotate in the same sense, but move backwards for a space, and then proceed to swim forward again in another direction ; or it may avoid the obstacle in a more direct manner by

describing a curve with its fore part; a curve of this kind may carry the animal completely round to the opposite direction.

Spirostomum is a relative of *Stentor*. This has a body which is over two millimetres long, and about one-fifth of a millimetre broad, and is thus thread or worm-like. Its possession of muscular fibres renders it highly capable of contraction; when it comes up against any kind of resistance, the animal can move its fore part tentatively to and fro, until it finds a way out. In other cases *Spirostomum*, when it strikes upon an object, can move the fore part of its body exactly like a worm, and glide past the obstacle. In another infusorium of this class (*Loxophyllum*) we may have, according to the situation in which the animal finds itself, both investigatory motion of the fore point of the body, and wavelike movement of the whole, as well as the most various twists and turns.

We may say, to sum up: even the protozoa, which have been described as the "lowest" animals, since their body consists "only of a single cell", do not react in an automatic and stereotyped way to the peculiarities of the external medium, but rather—of course in accordance with their organization—as whole individuals, and in a manner highly variable and suited to the situation. In their case, a single cell executes all that in other animals, and man, can only be done by millions and milliards of cells acting together. Regarded "from the protozoan point of view" we can also say that for this reason these single-celled creatures must be regarded as the "highest" organisms. A central organ differentiated in structure,

and capable of maintaining unity of behaviour, is missing in the case of the protozoan cell; and hence we are obliged to regard the cell body as a whole as its own centre, which then sends suitable impulses, according to the nature of the situation, to the various cell organs.

CHAPTER IV

More concerning the individuality of animals possessing numerous like organs of locomotion —The free-swimming Turbellaria and Starfish.

IN the last chapter we dealt with the unicellular animals, the protozoa. We chose as our main example *Paramecium*, and saw that it possesses, in the form of its cilia, many thousands of exactly similar locomotive organs, each of which, when separated from connection with the body, carries out independent motion of a completely stereotyped kind. On the other hand, as long as it is connected in a normal manner with the living cell, it always obeys the unitary impulses proceeding therefrom. In the case also of multicellular animals, the metazoa, we frequently meet with the possession of cilia, which cover, to a greater or lesser extent, the surface or the internal cavities of the body. In smaller forms of metazoa, which live in water, this ciliary coat covering the body frequently serves for locomotion, and we will now see whether, in these cases as well, it is subjected to unitary central impulses.

Speaking quite generally, the bodies of metazoa exhibit a division of labour among the cells, which finds its expression in a variety of structure. The nerve cells act as the central organ ; only in the case of the sponges are they absent. In the case of freshwater polyps (*Hydra*) and their related forms, they are distributed fairly

uniformly in the body, being connected with one another by nerve threads; they thus form a diffuse central nervous system. But in the animal kingdom, a compact central nervous system is commonest, and we find at least the vast majority of the nerve cells concentrated in definite regions of the body; in vertebrates, for example, in the form of the brain and spinal cord. We then only find a small number of nerve cells in other parts of the body, for example, in the heart or intestines. These give the organs in question a certain independence in their activity; but these peripherally situated nerve cells are by no means completely independent as regards transmission of impulses, but are connected by nerves with the rest of the central nervous system, and are always under the control of the latter.

Also in the case of the metazoa, the cilium element is formed of the single hair and its root. The cilia are collected in considerable numbers on the surface of the so-called ciliary cells, and these are then united to form larger aggregates, the ciliary epithelia, which may be of quite different sizes, from case to case. As long as no disturbance occurs from outside, the activity of the cilia, both those on an individual cell, and upon the whole ciliary epithelium, is perfectly co-ordinated. That is to say, they beat in a single direction, those alongside one another beating, as in the case of the infusoria, together (synchronously), while those behind one another beat in succession (metachronously), so that uniform waves of motion pass over the ciliary epithelium.

Epithelia of this kind may, according to the nature of the animal, have various biological "duties" (the concept

"duty" being, of course, meant in the fictional sense). We are able to distinguish two kinds of ciliary epithelia according to their function; one kind works invariably, and always, in one and the same direction, and is free from the influence of the central nervous system. In this class we have, for example, the epithelia which cover the inner surface and gills of shell-fish; they transport particles of nourishment, which were embedded in the mud, towards the mouth. In the case of snails, which move along a path of slime which they produce themselves, the cilia distributed upon the lower surface of the animal take care that the secretion of slime is uniformly distributed. In man, also, we find ciliary epithelia, for example, in the air passages to the lungs; the motion of the cilia is directed towards the nostrils, and its purpose is to transport mucus, and the small foreign bodies contained in it, outwards from the body. Ciliary epithelium of this kind, in which the beat of the cilia takes place unchanged in one and the same direction, and is independent of the influence of the central nervous system, may be described as the irregular type.

As opposed to this, we have the regulatory type, in which the motion is subjected to a central influence. In this class belong the infusoria, for we saw that in their case the activity of the cilia is regulated by the whole cell. Both regulatory and irregular epithelia may actually occur in one and the same species of metazoa, for example, in many water snails. Where we have regulatory cilia they usually serve for locomotion, and allow the animals to swim about freely in water.

We may take as our illustration the native turbellarians,

which live in water, and the smaller and almost microscopic species of which possess regulatory, and the large species irregulatory cilia. The first-mentioned forms are rod-like, the latter are flattened and rather leaf-like. The central nervous system of turbellarians consists of a pair of ganglia situated at the fore-part, and nerve-cords running backwards; the possession of numerous muscles gives the body of the animal great power of motion. In the case of animals covered with irregulatory cilia, the beat is always directed backward; the species in question creep in the manner of snails along the bottom of the water in a path of slime which they secrete, locomotion not being effected by the cilia situated on their lower surface, but by very fine muscular motions. The cilia situated on the rest of the body surface produce a continual current of water past the animal, which serves on the one hand for breathing, and on the other hand for the discovery of prey. The beat of the cilia always remains the same, whether the individual is at rest, moving straight forwards, or moving in a curve, etc.

Matters are quite otherwise in the case of free-swimming turbellarians, which possess regulatory cilia. Here the covering of hairs serves for locomotion, and works exactly in the manner with which we are already familiar from the infusoria, namely, in unison, and in the most variable modes of response to the momentary situation. And not only is there the strictest agreement between the activity of the various cilia, but also between ciliary motion and muscular contraction. It is quite evident that both systems of organs receive at the same moment co-ordinated impulses, which in this case, where a central nervous

system exists, must obviously be regarded as proceeding from it.

By means of a narcotic we are able, both in the case of free-swimming and of creeping turbellarians, to put the central nervous system out of action for a certain time. In every case muscular motion then ceases, and the bodies of the individuals remain stiff and motionless as long as insensibility continues. Ciliary motion, on the other hand, does not cease. Worms which normally creep lose, under a narcotic, contact with the bottom, and are then driven through the water by the backward, stereotyped beat of their ciliary covering, until they strike against some object and are thus held up; but their cilia continue to work uninterruptedly. Recovery from the narcotic is signalized by single muscular contractions; these gradually become more frequent, and the animal finally makes an active endeavour to regain contact with the bottom; and then, completely awake, proceeds to creep about in the usual manner.

In one of the free-swimming turbellarians, a narcotic leads to the central nervous system losing control both over the muscles and over the cilia. As a result of the stiffening of the muscle the body becomes like a piece of wood, the variability of the ciliary motion ceases, and gives place to a completely stereotyped beat. In other words, during narcosis the impulses cease, which normally change the ciliary motion from moment to moment, and suit it to the immediate situation; the ciliary elements become autonomous, but are only able to carry out on their own account a stereotyped beat—a fact already known to us from the isolated ciliary elements of Para-

mecium. In these narcotized worms, the cilia beat sideways and backwards; as a result, the body moves forwards with a clockwise rotation. Since the animal is not able to avoid obstacles, it arrives sooner or later in a corner and remains there until it gradually recovers from the narcotic. Its reawakening is heralded by muscular contractions, which mainly lead to the animal freeing itself, on meeting an obstacle, by suitable twists of its body. After a short time, modification of the beat of the cilia begins, together with stronger muscular contractions, and finally, the individual returns to its normal condition.

We have therefore succeeded in eliminating by narcosis in the case of the freely swimming turbellarians, the influence of central nervous system, which is well defined anatomically. But is it therefore permissible for us to say that we have been able to turn the turbellarian during narcosis into an infusorian-like creature? It is easy to see that such a view would be completely wrong, for, though it is true that the infusorian is devoid of a separate central organ, it possesses such an organ to all intents and purposes, inasmuch as the whole of its protoplasm forms such a centre, from which impulses proceed to the cilia according to the momentary situation. The uninjured infusorian is therefore a complete organism with all necessary qualities and powers; the narcotized worm, on the other hand, is incomplete in one important respect, namely the power of its central nervous system to function.

In the case of the infusoria and free-swimming turbellaria therefore, the locomotive apparatus consists of a large

number of similar parts, the cilia. In this connection we may discuss another group of animals, whose motor system differs very widely from the forms we have been considering; but nevertheless possesses a feature in common, namely, that here also a large number of similarly constructed elements, working together in a co-ordinated manner, bring about steady motion of the whole animal. I am referring to the echinoderms, of which at least the sea-urchin and the starfish will be known to you. These animals, in contrast to the majority of other animals, are not bilaterally symmetrical, but constructed on a starlike plan. It is possible to divide their bodies by means of several—most frequently five—imaginary planes, each of which separates into halves which are mirror-images of one another. The most obvious example of this is afforded by the five-ray symmetry of the starfish, the body of which is prolonged into five arms. A chalky skeleton gives its body a certain rigidity; but this skeleton is divided into numerous parts which are capable of relative motion, so that the animal is able to use its muscles to bend and twist in all sorts of ways. The mouth is situated centrally on the lower side; and from it a furrow extends along each arm. The central nervous system and the locomotor system are likewise situated on the lower side of the body. The former, in the case of the starfish, is not situated inside the body, as in the case of most other animals, but is freely exposed on the underside. It consists of a ring of nerves which surrounds the mouth, and five radial nerves belonging to each of the five arms. In the region of the mouth, and in the furrows running along

the rays, are many hundreds of minute feet, each of which carries a sucker at its outer end. These feet are characterized by great mobility, and are able to stretch out and withdraw. They are hollow, and filled with a liquid; each foot possesses a cavity which extends into the body, and which, when contraction occurs, takes up the excess of liquid. All the feet of one arm are connected by a longitudinal tube, the radial water vessel, which, alongside the radial nerve, runs along the furrow of the arm; and the five radial vessels are connected among themselves by means of a circular canal which runs along the mouth. Functioning of the feet occurs as the result of impulses sent out by the central nervous system; as the starfish creeps, it plants its feet in one and the same direction against the bottom, stretches them, and thus pushes its body in the opposite direction. The feet then release themselves from the bottom, swing back, and proceed to take another step in the manner described. Accordingly as the feet work alternately or in unison, the motion is continuous or in jerks. The animal is able to creep in any direction with reference to its body, the single arms then being stretched or curved in the most various ways.

We must not underestimate the achievement of the animal in being able to co-ordinate all its feet and cause them to operate in one and the same direction. Let us first consider those feet which belong to one and the same arm. Let us imagine these first stretched straight out, the radial nerves lying in the long axis. All the feet, in performing their to-and-fro movement, are set at the same angle to the nerve, as seen from above. But

as soon as an arm is bent during locomotion, the individual feet may form, seen from above, the most various angles with the respective nerve. The matter becomes still more complicated when we consider feet belonging to different arms; for these have to take up with respect to the long axis of their arms entirely different angles, if they are to press against the ground in such a way as to act always in the same direction.

The common feature, as I have said, of starfish, free-swimming turbellarians, and Paramecium, is that their locomotor apparatus consists of a large number of similar individual elements, the feet or cilia as the case may be, and that these, by working in strict co-ordination, produce a unitary movement of the entire body. These animals also, therefore, supply us with examples of our two fictional rules: "The end determines the means", and "The whole determines the parts". For "whole", and "end", are in both cases the total locomotion in a definite direction; and to these are subordinated the "means", or the "parts", that is to say the motion of the individual feet or cilia as the case may be, to meet the momentary situation.

If we turn a starfish on its back it bends the points of its rays round until the feet upon them are able to touch the bottom. The feet of one arm then begins to contract and to pull over the body, whereby more and more feet belonging to this arm are able to take firm hold of the bottom; the arms on the other side assist the process by pressing against the bottom and thus levering the body over. In this manner, the starfish is able to regain its normal position in a very short space of time.

Some have wished to discern opposition in the functioning of the five arms in the fact that the starfish at first generally bends all its arms, and so brings the feet at their points in contact with the ground. The five single arms were thus regarded as five individuals, and each was supposed to begin to operate in a particular direction. The final overturn was then supposed to come about by a compromise between the five forces opposing one another. In an extreme form this was formulated as follows: the "I" of the starfish is made up of a "We", of the single "I's" of the five arms; this was described as the "We in the I". Of course, the reference to an "I" was purely metaphorical; the starfish was not supposed to possess a conscious ego. Nevertheless, this view is certainly to be rejected. For as far as one can see, the five arms do not behave like five draught animals, harnessed to a cart and striving to move it in five different directions, the decision as to the direction of motion of the cart being given by the relative strength of the animals. We do not assume a functional opposition between the right- and the left-hand side of the body in the case of an organism which is bilaterally symmetrical, and we have no more right to assume such an opposition between the similarly constructed parts of a five-rayed animal. If we lay a bilaterally symmetrical organism, for instance, an insect, a crab, or a frog, upon its back, it usually performs, during the first moments, grasping or searching movements with all its extremities, until they have found a hold upon the ground or upon some solid object; whereupon the animal immediately turns over with a single unitary movement. Accordingly, we must regard

the bending of the starfish's rays as exploratory movements, which enable it to discover a hold ; as soon as it has found this, co-ordinated impulses proceed to all necessary parts of the body : the muscles, which move the arms, and the feet. Thus, its regaining a normal position appears from beginning to end as a completely unitary act.

If we cut a starfish into two or more parts, we divide its individuality in the corresponding manner. Each single isolated arm is capable of continued existence ; it crawls about and finally regenerates four new arms, and in the end becomes a complete starfish. If we divide the ring of nerves surrounding the mouth at two points, without otherwise injuring the animal, we obtain two half-animals which are completely independent as regards their central nervous system ; within themselves these two parts act in perfect co-ordination, but as regards one another they exhibit no further functional relationship, in spite of the fact that they are still mechanically connected. Locomotion, overturn, and so on, now only result in a compromise between two forces acting independently of one another. This contrast between animals in which the central nervous system has been divided into two, and intact starfish, exhibits to us, in the clearest possible manner, the fact that all the movements of the latter always take place in a unitary manner.

By way of conclusion we may consider the sea-urchin. Its body is spherical ; but we are able clearly to distinguish in it five-rayed symmetry. The function of its feet is another than in the case of the starfish, for they do not push the animal forward by stretching, but pull it forward

by contraction. But the same is true in principle for the sea-urchin as for the starfish ; if the animal is on the move, its feet swing to-and-fro in one and the same direction in space ; but with respect to the particular fifth section of the body to which they belong, this direction is in each case a different one, and when the animal changes the direction of its march, the mode of motion of its feet must change in a corresponding manner. The sea-urchin, as compared with the starfish, possesses still another means of locomotion : walking on its spines, and this usually occurs under strong stimulus, and enables the animal to move faster than when using its feet.

The spines of the sea-urchin are longer than those of the starfish, and extremely mobile ; when used for locomotion they are swung to and fro, and as regards the relationship of this movement to the divisions of the body upon which the spines are situated, we may say the same as we have said in reference to the motion of the feet.

CHAPTER V

The individuality of jointed animals, annelids, and arthropods —
The supposed antagonism between the right and left side of
the body.—Theories of tropism, and the theory of tropotaxis.

ACCORDING to the definition we have given, individuality is not a matter of the indivisibility of the organism, but of the unitary operation, in undisturbed connection, of all the parts. We have hitherto dealt in greater detail with the slipper animalcule (*Paramecium*), the free-swimming turbellaria, and the starfish. These various animal forms, in themselves entirely different, have this in common, that their locomotion is effected by a large number of similar single organs: in the case of *Paramecium* and turbellaria, these were the cilia, and in the case of the starfish the suckers. These examples made it particularly evident that the process of locomotion can never be understood from the individual motions alone, but only as a unitary function of the whole. We will now consider animals the bodies of which are built up out of a number of parts which are completely or closely similar in construction, and arranged one behind the other; such animals are the annelids. They are known to everyone by at least one species, the earthworm (*Lumbricus*).

As the name indicates, the bodies of the annelids are made up of a number of separate rings or segments, the majority of which are identical in form both externally

and internally ; the organs, therefore, both on the exterior and interior of each segment, are the same in all. At the front end we find a more or less elaborately constructed head, which in the case of many species living in water, may possess feelers, eyes, and other organs. In this connection we are particularly interested in the nature of the muscular and central nervous system. The former consists in both annular and longitudinal muscles, which lie in the wall of the body. The annular muscles diminish by their contraction the diameter of the segment to which they belong, and cause it to increase in length. The longitudinal muscles operate as antagonists of the annular muscles, that is to say, their contraction shortens the segment, and increases its diameter. The central nervous system of the annelids is built on the plan of a rope ladder ; a system of this kind occurs, by the way, not only in this type, but also in the arthropods, which also possess segmental bodies ; the insects and crayfish belonging to this class.

It is characteristic of this type of nervous system, that each segment of the body possesses on the ventral side a pair of ganglia ; and these contain the nerve cells. The two ganglia are connected together by a nerve cord ; and connection also exists between the ganglia of neighbouring segments. It is thus that we get the plan of a rope ladder. In the head we get two special pairs of ganglia, the supra and infra-oesophageal. The first lies, in accordance with its name, above, and the second below the beginning of the gut ; the connection between the upper and lower ganglia is made by the oesophageal connection to right and left of the intestine. The upper

pair of ganglia is called, in the case of the annelids and arthropods, the brain, since it is the seat of the highest nerve centres. Secondly, the two ganglia in each segment of the body may combine to form a single structure, so that the rope ladder becomes a cord extending along below the intestine, with a swelling at each segment brought about by the union of the two ganglia. At the fore end this cord divides into the two connections which proceed to the brain. In the case of earthworms, each pair of ganglia controls that segment to which it belongs. We will first consider an annelid living in the sea, *Nereis*. This worm grows to several centimetres in length, and since it occurs along all our coasts it can easily be sent alive from one of the marine research stations. Its body is constructed of almost a hundred similarly formed segments, the front end is formed by the head. The section of an individual segment is not circular, but elongated, since it bears to right and left a movable projection which carries a number of bristles. These stump-like projections (parapodia or parapods) are the organs of locomotion.

Nereis lives in the fine mud, and moves forward by creeping in it; it is also able to leave the bottom and swim for a space, though not very skilfully. Its slowest type of crawl consists in the body remaining stretched straight out, and in the passage of waves of motion over the parapods on the right and left side. The animal thus moves forward over the bottom. In this type of metachronous motion, neighbouring parapods are therefore never in like phase of activity, the more forward parapod is always a little in advance, in its motion, of

the one behind it. It is also important that the parapods to left and right of the same segment are as a rule functioning in opposite phases. The metachronous waves passing along the right and left of the animal's body remind us of the moment of the cilia of *Paramecium* and of other such organisms, in which, as we have seen, elements lying behind one another are similarly different in phase

When an animal at rest begins to creep slowly forwards, the wave motions of the parapods may begin at any part of its body, and not necessarily at the fore part ; the waves do not always proceed as far as the hinder part, but may end at any part of the body. By an action of this kind, the animal is able to move very slowly over the bottom. While the co-ordinated function of the cilia of *Paramecium* is governed by the whole cell, and in a free-swimming turbellarian by the central nervous system, in the case of *Nereis* the metachronous movement of the parapods depends upon the central nervous system. If the worm, when crawling, meets a resistance of any kind, it may move backwards for a space ; this is brought about by a reversal of the motion of the parapod ; but in this case also, the parapod situated nearer the head is in advance in its motion as regards that of a parapod situated nearer the tail.

The forward creep of *Nereis* is more rapid when the animal makes snake-like movements in conjunction with the functioning of its parapods. When this happens, the parapods on its convex side are always in the phase of backward movement and those on the concave side perform their forward motion. The snake-like motion

along the bottom may pass over into swimming, whereupon the movements, which are still performed in the horizontal plane, become livelier and greater in extent. When a resting animal is stimulated by being touched suddenly, it makes use, as a reaction of its body as a whole, of the contractile reflex, by means of which it contracts with lightning rapidity. If we divide the central nervous system of a *Nereis* at any point, which is an easy matter, we divide the worm thus into a "fore-animal" and a "hind-animal", which are then completely independent as regards central nervous reaction, and are only connected in a purely mechanical manner. We have divided the individuality of the worm into two parts. It then happens that the fore-animal and the hind-animal may be acting in entirely different ways, without any connection with one another. For example, the former may creep along the bottom, while the latter is inactive, and hence is passively towed behind the other. Or the hind-animal may be in motion, and the fore-animal at rest, a state of affairs which, however, is more seldom realized, since the fore-animal possesses the highest centres localized in the brain, and hence is characterized by greater liveliness. The mode of motion of one half of the animal may be secondarily transmitted to the other half; for example, the resting hind-animal may be carried forward passively for a space, which process then results in stimuli of various kinds, and finally lead the hind-animal also to make locomotive motions. Thus we may have, for a time, more or less unitary creeping or swimming, until one or other of the half-animals returns to a state of rest. This state of inactivity then

either extends to the other half as well—probably on account of the powerful mechanical resistance given by the drag of the other half ; or, on the other hand, the inactivity of the resting half lasts only for a short time, since the persistent activity of the other half causes it to begin to move again.

Exactly corresponding results are obtained when we divide the individuality of the worm into three parts, by cutting the central nervous system at two points. We may take for further experiments the earthworm (*Lumbricus*). This is fundamentally similar in construction to the Nereis. Its body consists of well over one hundred segments , it is, however, devoid of a well-developed head and the extensions to the segments known as parapods. Hence its section is approximately circular. When creeping over the ground, it takes hold by means of fine bristles, which are situated, regularly arranged, on the lower side of each segment. One can observe the presence of these bristles by laying an earthworm on its back and stroking its belly from front to back with the finger. The creeping motion of the earthworm begins with an extension and stretching of the forward end. The resulting contraction of the body passes as a wave backwards along it and is followed by a thickening and shortening of the segments ; in this way the forward creeping earthworm exhibits several waves of thinning and thickening directly behind one another, which pass in the form of peristaltic movements along the body. This peristalsis is caused by the antagonism between the annular and longitudinal muscles ; the first effect contraction and stretching of the segments, the latter thickening and

shortening. In this process, the parts which are stretched move forward a space each time; they then grip the ground by means of the bristles, and the shortening of the segments then results in forward motion. If an earthworm is stimulated at its fore-end, it either turns aside one way or the other, or it creeps backwards for a space, the sense of the peristalsis being reversed. In this case, the waves of thinning and thickening arise at the hind-end and travel from this forwards over the body, with the result that the animal moves tail forwards. If the earthworm is touched suddenly, it possesses, like *Nereis*, a contractile reflex as a reaction of the whole body, which draws together with great suddenness.

By means of a cut through the nerve thread, we can divide the earthworm into a fore and hind animal. Here again we obtain two half-animals entirely independent of one another as regards central nervous reaction. Accordingly, co-ordination of movement between the fore- and hind-ends disappears. For example, a sudden contact causes contraction of only one half and not of the other. Only in one case do we observe, even after severance of the cord, co-ordination between fore- and hind-animals. If the fore-animal commences to move, peristalsis begins at its front end. But when this reaches the point of injury, we are surprised to find that it does not cease there, but passes over into the hind-animal; the result is that the two half-animals, whose central nervous systems are separated from one another, nevertheless creep forward with uniform rhythm. (Friedländer was the first who made this experiment and some of those subsequently described.) By way of explanation we

must assume that peristalsis is not set going by central nervous impulses alone, but that a further process taking place in a reflex manner in each segment is also concerned ; passive extension of the longitudinal muscles of a segment causes active contraction of the corresponding annular muscles ; and this process again brings about active contraction of the longitudinal muscles. A further experiment confirms the fact that this transference of peristalsis from the fore-animal to the hind-animal, after the performance of severance, is a purely mechanical matter. We divide an earthworm into two parts and join the fore- and hind-animal by means of a thread, which may be of any length. The two half-animals then move in complete independence of one another as long as the thread is not tightly stretched. But as soon as this happens, that is to say as soon as the fore-animal drags the hind-animal along for quite a short distance, connection being made by the tightly stretched thread, the hind-animal begins a peristaltic movement, and the two halves creep along with a unitary rhythm. The experimenter is able himself to assume the rôle of the fore-animal ; he may take hold of the thread and exert a tension on the hind-animal. As soon as this is done the latter commences peristaltic motion, beginning from the fore-part, and this continues as long as the thread is pulled. A further variation of this experiment is to connect two intact earthworms by means of a thread, tying the hind-end of one to the fore-end of the other. Invariably, as soon as the thread is stretched and the fore-animal begins to drag the other, co-ordinated locomotion is set up.

We must not think, however, that experiments of this kind give us a "mechanical explanation" of the creeping of an earthworm. I have already remarked that the mechanical element is only one of two components entering into the locomotion of this worm. It is obvious that the mechanical pull is less important than the central nervous impulses, which first of all set the motion going, and then likewise take care of the further continuation of peristalsis. The fact that the characteristic motion of creeping is also regulated by the central nervous system may be shown in the following manner. We secure an earthworm to a suitable base and remove the whole of the tissue in the middle of the body with the exception of the nerve cord. In this experimental arrangement the worm is unable to move away from its position, but nothing prevents it carrying out peristaltic movements. We now see that the peristalsis which takes place in the fore-end of the animal passes over into the hind-half, although no mechanical pull is exercised on the latter, since the animal is fixed and unable to move. This proves that the central nervous system is also able to maintain peristalsis; the mechanical pull, the significance of which we have just discussed, is by no means solely decisive, but merely has the task of supporting the central nervous system in its total function by exciting reflexes in the segments. It should be specially emphasized that in the case of the earthworm with its central nervous system severed, a co-ordination between the two halves can only be set up in a purely mechanical way as regards this one activity, namely creeping; every other kind of co-ordination is entirely abolished after severance.

Hence even animals the bodies of which are built up of a multiplicity of similarly constructed segments, can never be regarded in reference to their behaviour merely as the sum of the parts, but only as wholes. We will now consider the further question whether, in the case of bilaterally symmetrical animals, any activities can be explained additively from the single function of the right and left side of the body; or whether in this case also such an explanation always fails, thus compelling us to regard their behaviour from the point of view of the whole.

Loeb formed the following conception of the manner in which a bilaterally constructed animal attains or avoids a source of stimulus. Suppose, for example, an animal having a right and left eye, such as a worm, crab or insect, is near a lamp, and is striving to reach it. As long as the animal is not symmetrically situated with reference to the stimulus, that is to say, as long as the lamp is not exactly on the prolongation of the axis of its body, one eye is more strongly illuminated than the other. Loeb now assumes that the sense organs of one side, including the eye, are mainly connected through the central nervous system with the muscular organization of the opposite side of the body, so that the optical stimulation of one eye results in the opposite side of the body being chiefly stimulated. Hence, in the case in question, the system of muscles connected with the more intensively illuminated eye would work more powerfully, until the animal came into a symmetrical position with reference to the light. Hence, according to Loeb's theory of *tropism* (as it is called), the behaviour of a bilateral animal is to be explained mainly as resulting from the

addition of the functioning of the two sides separately. The locomotion of the animal would thus be effected in much the same way as that of a boat rowed by two oarsmen, one on one side and the other on the other. If the two work with equal power, the boat moves straight forward ; if one rows more strongly, the boat will move in a curve in the opposite direction. Let us consider in detail whether, and how far, the behaviour of animals ever corresponds to the theory of tropism. Let us first take the example in which the animal moves towards a source of stimulus. This is called positive phototaxis. As we have stated, the theory of tropism has it that the legs on the side away from the light work more strongly, until the animal has described a curve and brought itself into a symmetrical position with respect to the light, from this point the muscles of the right and left leg are equally stimulated, and the animal moves in a straight line towards the light. But if we observe an insect which, to begin with, is unsymmetrically situated with respect to the light, we see that the symmetrical orientation is by no means produced solely by stronger action of the limbs on the side away from the light, causing the animal to be driven in the opposite direction. On the contrary, its turning towards the light has the form of a completely unitary act, in which the legs of the two sides of the body work in co-ordination with one another. It is as if in the boat which we have referred to, we had one man working both oars. If he wishes to cause the boat to turn, he is not limited to causing one oar to work more strongly than the other, but may also proceed to row backwards with one oar and forwards with the other,

until the boat points in the desired direction. The insect behaves in precisely the same manner; it does not only walk in a curve until it sees the light source equally with both eyes, but may at the very beginning jump round with a single movement and take up its final position.

We may now take the case of insects which avoid the light; their behaviour is called negative phototaxis. Such an animal, also, must as a rule make a turn, but not this time in the direction of the more strongly illuminated eye, but towards the less illuminated. The production of this movement obviously cannot be explained in the same way as the turn in positive phototaxis. On the contrary, Loeb is compelled to assume that, in the case of negative phototaxis, those legs on the opposite side to the more strongly illuminated eye receive less energy than those on the other side.

In order to save his principle that the orientation of bilaterally symmetrical animals comes about by separate working of the two halves of the body, Loeb is driven to this very artificial point of view.

As a further example, we may take a flat-worm, one of the creeping turbellarians already known to us. These animals possess eyes at their fore-end; let us take a case in which there is one eye on each side. Turbellarians usually avoid light. If we bring such a worm near a light, it turns away from it. This turning motion results, according to the theory of tropism, from one eye receiving more light than the other, this sends a stronger impulse to the muscles on the opposite side, with the result that they are more strongly contracted, and so bend the animal's body. But when, as may happen, some worm

or other strives to reach the light, that is, when we have positive phototaxis, the tropism theory compels us to assume that the half of the body opposite to the illuminated eye receives a less quantity of energy.

In North America, the theory of tropism still possesses a number of adherents; in Germany, various authors (Kühn, O. Koehler, Herter and others) have developed it further into a theory of *tropotaxis*, which, it is true, is an improvement in refinement of its predecessor, but nevertheless is subject to the same fundamental error, namely, that according to it an animal does not react to a source of stimulus in a unitary manner, but additively by the parallel, or even opposed, operation of the right and left side of its body.

Obviously the main reason why the theories of tropism and tropotaxis still find some adherents is that when experiments are done in two dimensions, and the results are represented on paper, the interpretations appear so attractively simple. But if we work in three dimensions, the theories of tropism and tropotaxis inevitably fail. Let us place in a dark room a winged insect upon a table, having placed over the latter a lighted lamp. The insect rises in the air and makes straight for the lamp. How is this possible according to the two theories? For they are only able to explain the guidance of a bilateral organism by the parallel operation of the right and left side of the body in one plane, for example, that of the table; but since the insect is able to leave this plane, and reach a goal, by a diagonal path, is a fact which is entirely overlooked by the two theories. The same is true for water animals, which do not always swim parallel

to the earth's surface towards the light, but may, under suitable experimental conditions, also reach it by a movement up or down. These theories are quite unable to deal with all such cases which take place in three-dimensional space, since there is no such thing as a second plane at right angles to the medial plane of the animal's body, and dividing the latter horizontally in two similar halves. For the reasons we have given, the theories of tropism and tropotaxis must be rejected ; above all, they contradict fundamental axioms that vital events cannot be regarded as summations, but always only from a unitary point of view.

CHAPTER VI

Understanding and explaining—The attempt at sympathetic understanding of animal behaviour—Intra-central orientation and disorientation of animals—Comparative physiology of the senses and nerves in animal psychology.

IN the biology of the last decade, a great part has been played by the fiction that the living body is a machine, and can be understood in its functions as we understand a machine. We have set up against this the fiction that the organism is something entirely different in nature from inorganic matter. The difference between living and non-living nature in the light of this view was discussed at length in the first lecture. We will now assume further that all other organisms are allied in nature to us human beings, and to a greater degree, the nearer they are to us in systematic classification. In this sense, therefore, the plants and lower animals are very far removed from us: but the further we rise in the zoological system, the more similar do the animals, in a general way, become to human beings in their nature.

When likenesses in nature exist, understanding is possible. This brings me to the difference between "understanding" and "explaining". (I am using these two terms in a somewhat different sense from the psychological school of Heidelberg.) Understanding is something primary, something which is set up directly, while explaining is something secondary, in which the main

part is played by experience and rational consideration. I observe, for example, that a pair of birds fall, when I approach their nest, into very rapid motion, flutter around, and emit continual cries. I can attempt to grasp this process from two sides, either by striving to understand it by sympathy, or by attempting to explain it from the physiological processes taking place in the senses, nerves, and organs of motion of the two individual birds. It appears to me that sympathetic understanding is able to bring us into a more direct relation to the observed facts, and that explanation from physiological processes can play in this case only a more modest part.

On the other hand, my understanding fails me when I watch the same pair of birds building their nest. For in the case of ourselves, the construction of so complicated an affair is something that must be first learned by example; but the bird's power of building its nest is inborn, and when the time of pairing arrives, it builds the nest characteristic of its species, even when it itself was not brought up in such a nest, and has never in its life seen one. It is here that a limit is set to my understanding, if I attempt to assume that the bird possesses a psychical constitution analogous to my own, there is no inward resonance in my own mind which tells me what passes in the bird while it is building its nest. I have no alternative but to use my experience as a biologist to "explain" the whole process by saying that this particular power is inborn in this particular bird.

Of course, understanding and explaining are not crass opposites, and there are numerous cases in which understanding and explaining are both mingled as far as I am

concerned. Such a case is when the duck mother leads her new-hatched children immediately to the water. The instinct to take care of offspring is one that I can understand through direct human experience; the fact that the female duck also has an inward compulsion to take its children to water is something that I cannot inwardly understand, but must explain from my general knowledge by saying that this is a characteristic of ducks and other aquatic birds.

Furthermore, even in the case of my fellow human beings I am not able to understand everything, but and in many cases compelled to limit myself to explaining behaviour which I observe. An unmusical person, for example, is entirely unable to put himself in the place of a musical person listening to a concert, he simply learns by experience that a certain musical person exhibits, on hearing a certain piece of music, an emotional reaction, while other pieces of music do not produce this effect. The same is true as regards the attitude, as observed by the unmusical person, of musically inclined people towards executants: one of the latter will be appreciated, while another will receive no applause. After a sufficient time, the unmusical person is able to foresee how a definite person, or number of persons, will react when such and such an artist plays a certain piece. But he will not understand this sympathetically, but simply be able to explain it on the basis of his previous experience.

The healthy person's power of understanding frequently fails him when confronted with the mentally ailing, and there remains only the method of explanation. In a situation the danger of which we recognize objectively,

we are able to understand directly the expression of fear, but the healthy person fails to understand the behaviour of a person suffering from persecution mania for example, and he is obliged to accept the explanation of the psychiatrist, that in this disease the symptoms of persecution mania appear.

It is also evident that understanding and explanation are not irreconcilable opposites as regards the behaviour of our fellow-men. It may often occur that I understand an action to a large degree, but there remains to me a residue, which, in spite of my best efforts, can only be explained. In other cases, I may be dealing with behaviour which in the main I can only explain, nevertheless there may be some point where I can understand and sympathize

It is only psychical processes—or more correctly their mode of expression—which can be understood; bodily functions such as the activity of the intestines or the heart, growth, etc., are always only susceptible of explanation. I believe this also to be true, even when we set up the fiction that these functions are the manifestation of a psyche-like agent working for the maintenance of the individual whole.

So much for the difference between understanding and explaining. We will now consider more fully to what extent we may dare to attempt to grasp the behaviour of animals by understanding. In the last chapter we spoke of animals which run directly either towards or away from a source of light. This behaviour is called positive and negative phototaxis. The animals themselves are described accordingly as photopositive and

photonegative ; on account of their inner distribution, their photopositivity or photonegativity, we have them exhibiting positive or negative phototaxis. We take a photopositive animal—a crab or an insect—and vary the experiment already described by using, in a darkened laboratory, not one source of light, but two. The two lamps are of equal strength, the starting point is equally distant, and at the commencement of the experiment the animal sees them symmetrically. Several possibilities of behaviour then exist. The animal may run directly towards one lamp, without taking any notice of the other ; or it may run for a space along the line midway between the two lamps, and decide later for one or the other ; or it may move in a zig-zag for short distances first in the direction of one lamp and then of the other, its path finally ending at one of them. If we experiment with one and the same animal several times in succession, these various forms of track may appear in the most various fashion. According to the theory of tropotaxis, a photopositive animal reaches the lamp on that side from which its eyes are more strongly illuminated. If the animal, therefore, runs from the start towards one lamp, it is assumed that this lamp sent a stronger light to its eyes in the first place. If the animal moves a space along the midway direction, the light stimuli from right and left are supposed to be of equal strength, so that the animal, like a horse on two pairs of reins, is led along at an equal distance from the two sources of stimulus ; the decision, as to the side to which it finally turns, is supposed to depend upon its eyes being more intensively illuminated by one lamp in the course of a " chance "

turn. And the zig-zag course is supposed to be the result of more light falling "by chance" first from one side and then from the other upon the eyes of the experimental animal.

The theory of tropotaxis therefore degrades the animal to the level of a machine, which is directed by the rays of light hither and thither like a puppet on strings. As opposed to this fiction, that the behaviour of an animal is brought about as the sum of the opposed functions of the right and left side of the body, we have set up the fiction that the behaviour of the animal must always be regarded as a whole. According to this view, the animal therefore sees both lamps from the start. In one case, it decides straight away for one of them and leaves the other unnoticed; it "fixates itself intra-centrally" upon one source of light, and, eliminates the other intra-centrally, as I have termed it. Or the animal postpones a decision, and moves for a space along the middle line, only deciding later to turn finally to one or other source of light. Or the animal "hesitates intra-centrally" between the two sources of stimulus; the expression of this indecision is its zig-zag course, each change in its direction signifying a change in decision. While the theory of tropotaxis only explains the behaviour of the photopositive animal in the experiment with two lights, as due to the difference between the amount of light reaching the right-hand and the left-hand side of the body, I have attempted to understand by sympathy its behaviour in the manner stated above. According to the expression I have used, the animal "decides" either from the start or after having moved a certain distance; the animal is "un-

decided ", it " hesitates " between two objectives, and is able to " alter its decision ".

This kind of behaviour I observed in particular regarding the hermit crab (*Eupagurus*), with which I have made many experiments. All varieties of crab possess two pairs of feelers, and in the case of the hermit crab, the first pair is short and the second long. The latter pair are used for feeling, the first for chemically testing the water. This is effected by the crab beating the water rapidly with its first pair of feelers. It looks as if it were making signs in the Morse code. If the hermit crab sees any striking object, it is able to beat its feelers in that direction. The hermit crab does not move only, as do most other animals, symmetrically in the direction of its own axis, but it even more frequently moves in an oblique direction forwards or sideways towards its goal. This cannot be understood in the sense of the theories of tropism and tropotaxis, for when it is set obliquely to its path, the two eyes are unequally illuminated, and yet the animal arrives without deviation and along a straight path to the source of stimulus. The explanation is to be found in the fact that the reaction is that of the animal as a whole, and is not the result of the addition of the two halves of the body acting separately.

In the experiment with two lamps, the hermit crab either moves from the start in a straight line towards one of them, in which case it waves its first pair of feelers only towards this during its whole march. Or it may move for a space along the middle line between the lamps; in this case it rapidly changes from waving towards one to waving towards the other; this leads

us to conclude that the animal observes both lamps separately, but that it postpones for a time a decision as to which it shall approach. It is also important that the crab can move along this middle line with its body in any kind of oblique relationship to it, and this means that the two eyes may be entirely differently illuminated. We get a zig-zag course when the animal decides as it moves along its path, first in favour of one and then in favour of the other. If we alter the position of the start, so that it is not equally distant from the two lamps, the intensity of light reaching it from the two is not equal. Quantities of light are indirectly proportional to the square of the distances; if, for example, the distance to the one lamp is fifty centimetres, and to the other seventy, twice the amount of light reaches the crab from the first than from the second. Under these conditions, the hermit crab is able to decide from the start for either of the lamps; hence it is by no means "drawn" in the sense of the theory of tropotaxis towards that lamp from which at the start it receives most light. When the crab has reached one of the lamps, it may immediately leave this and proceed to the other; calculation shows that a lamp to which the crab is very close may be exposing it to a light one or two thousand times as strong as the other, nevertheless the crab leaves the one and runs towards the other. The animal is thus by no means "a slave of the light" or "of its sense organs", but is able to choose quite independently of the circumstances of the experiment and make a decision.

I have also experimented with the shore crab (*Carcinus*). This animal always proves to be photonegative, that is, it

never runs towards the light, but always avoids it. On the other hand, we are able to use, as objectives for it, black screens which were offered to experimental animals contained in a white vessel. These screens were five centimetres broad, about corresponding to the diameter of the individuals used. Exactly the same experiments could be done with these black screens on the photonegative shore crab as were performed with lights on the photopositive *Eupagurus*. One point deserves special notice: lamps emit light, that is radiant energy, and this circumstance has led a number of upholders of the theories of tropism and tropotaxis to refer the resulting locomotion of an animal towards a light or away from it to a kind of transformation of energy; according to this, the light energy is supposed to be transformed by means of the central nervous system into motor energy. But it is characteristic of black screens that they do not give out any kind of energy, nevertheless the motion of the shore crab is directed towards them. Hence the fact that an object serves as the goal of an animal is not decided by whether it emits energy, and how much energy it emits, but only by whether it can be distinguished from the surroundings by the animal.

In the case of the shore crab, we must distinguish two intra-central dispositions; one to running around, and another to seeking a point of rest. In the case of the first the animal runs only in the general direction of a black screen offered to it, but then runs past it and around in the experimental vessel; but when it was disposed to rest the crab runs straight to the screen and remains at it.

In the case of animals disposed to rest, it was possible to carry out experiments in the way we have indicated, and they were to correspond entirely with the light experiments on hermit crabs. In the presence of a black screen, the crab made for it straight from the start, though its body might be pointing in any direction; in the course of its movement its first pair of feelers beat rapidly in the direction of the goal. If two screens were set up, the animal might run towards one of them, the other being completely ignored—intra-centrally eliminated. Or the crab ran for a space along the middle line, thus postponing the decision as to which screen it was to aim at; its intra-central hesitation between the two goals was expressed by the fact that it waved its first feelers alternatively in the direction of one of the screens and of the other. Its course along the middle line could also be zig-zag; the animal ran alternately towards the right and left screen, finishing up at one or the other. It is of importance that all its movements, both in the case of one screen and of two, could be carried out with its body in any direction, that is, symmetrically forwards, sideways, obliquely forwards, and even for a space, obliquely sideways or symmetrically backwards. And even on one and the same run, it might change its orientation several times.

I already took the opportunity in the first chapter to stress the fact that, in the case of the hermit and shore crabs when making straight for a goal, the orientation of their bodies with reference to their line of movement is of no importance. But this appears to me to demonstrate most impressively the "wholeness" of their

behaviour. For at every change in the direction of the body other parts of the eyes perceive the goal, and each time the legs must move in a different manner, without any detriment to the directness of the motion towards the goal. For what decides the mode of locomotion is the intra-central fixation of the animal upon the goal; and according to the detailed nature of the situation at any moment, the "means" used to reach this goal are varied—in full agreement with the fictional axiom which we set up in the first chapter, that the end determines the means.

In discussions of the tropism and tropotaxis theories, a great part has been played by the behaviour of individuals blinded on one side in the experiments with single lights. In these cases, a photopositive animal so treated deviates towards the seeing side, a photonegative animal towards its blind side. This is explained by the tropism and tropotaxis theories by saying that the artificial asymmetry of the light receptors (the eyes) results in the muscles of motion receiving asymmetrical impulses, and this unequal functioning of the two sides of the body is supposed to result in a deviation towards that side acting less strongly.

We reject this view, and shall attempt to get nearer to the process by an understanding of it. We take a crab or an insect and blind it on one side. This can be done in two ways: either by coating the eye with an opaque black varnish, or by removing it. The effect is the same: the animal now only sees on one side, and is hence easily deceived as to the state of illumination of its surroundings; it can thus be deluded that brightness

exists only on its seeing side, and that its blind side is dark. According as we are dealing with a photopositive or photonegative animal, its behaviour is different; the photopositive animal turns towards the seeing side, the photonegative animal towards the blind side. This is the interpretation which has been given by V. Buddenbrock and myself as regards the behaviour of animals blinded on one side. If we hesitate to make use of the word "delusion" as regards an animal, we may say that the injury has "intra-centrally disorientated" the blinded animal as regards the stimulus situation. I have distinguished between the bodily orientation of animals in space, and their intra-central orientation concerning the peculiarities of the medium. According to the degree of its adjustment, an animal takes up a more or less correct orientation in space corresponding to the situation, and if it is completely disadjusted intra-centrally, behaviour out of correspondence with the situation results.

The concepts of intra-central adjustment and disadjustment are fictions, which the experimenter is able to abstract from his observations. He knows that in such and such a situation the members of a species behave in such a way, an intact photopositive animal, for example, makes straight for the light, while a photonegative animal makes straight away from it; if an animal blinded on one side wanders, it is wanting, in the view we have put forward, with respect to intra-central adjustment of the situation. If we test the behaviour of an animal blinded on one side in detail, we observe that adjustment and disadjustment frequently alternate rapidly. Sometimes the animal will attain or avoid the lamp by a straight

line movement, at another time it will wander. A change of this kind may even take place during one and the same run, that is, at times the animal succeeds with the aid of its one uninjured eye, in adjusting itself to the distribution of stimulus in its surroundings, but again falls into delusion due to being blind on one side. In the case of the photonegative shore crab, blinding and a black screen may compete with one another; in this case the animal runs at one time towards the screen, and at another towards its blind side.

In certain circumstances the degree of adjustment may gradually improve in course of the experiment; Urban was able to demonstrate this by experiments on bees carried out in the Zoological Institute at Marburg. Immediately after blinding, the photopositive animals ran in close spirals towards the seeing side, and thus only moved quite gradually towards the light. But the spirals gradually became longer, until the paths became straight. Temporary relapses into the original disadjustment might occur; that is to say, from time to time a single spiral movement might take place.

At the close of this chapter it appears to me advisable to define the limits between the comparative physiology of the senses and nerves, on the one hand, and animal psychology on the other. Hitherto these two terms have often been confused, so that in the case of many authors, matter belonging to the physiology of the senses was already regarded as ranking under animal psychology. Comparative physiology is concerned quite generally with the manner of functioning of single organs, that is to say, of the sense organs, the central nervous system,

and the effectors (for example, the muscles, glands, etc.). Or it investigates single processes, such as walking, flying, standing upright, digestion, and the like. Very frequently, the single organs cannot be completely separated for the purpose of investigation, from the rest of the body, but must be left in connection with it. The physiology of the senses and nerves then studies what the animal does in the presence and in the absence of a certain sense organ or part of the central nervous system. As long as a certain stereotyped character of behaviour results, and as long as it can be proved that the varying results are determined from outside—by artificial changes in the organs or by alteration in the experimental arrangement—we are dealing with physiology of the senses or nerves respectively. But as soon as the course of events varies in a manner which points away from such direct connections with external factors, and suggests factors of an internal nature, the task of animal psychology commences. Hence, comparative physiology of the senses and nerves is rather a study of partial processes, while that of animal psychology is a study of the behaviour of the whole, the main attention being directed towards variations produced purely intra-centrally.

CHAPTER VII

The animal's grasp of wholes —Super-individual wholes.

WITH the aid of our eyes we recognize a human being as such whether he is in our immediate neighbourhood or a certain distance away. His actually apparent size is of no importance for us ; furthermore, in the process of recognition, no part is played by the bodily position of the person recognized, or by our own. A man thus remains a man for us, whether he is standing or sitting before our eyes, so that we either see his right or left side, his front or his back, or watch him lying down, walking, running and so on. And, as we have said, the same is true for ourselves as observers ; whether we are at rest or in motion, and in whatever way, we always recognize in the same manner. Again, the most various types of human beings are immediately recognized by us for what they are, whatever may be their appearance and form in detail. We conclude from all this that recognition does not depend so much upon how many, and which, of the elements of vision are excited on our retina. Our eye is only the organ of reception, which transmits the stimuli received to our central nervous system. The act of recognition is a purely intra-central event, and this recognition does not merely occur when what is recognized corresponds to a single or a few types, but on the contrary, there are unlimited possibilities in

the ways in which optical impressions of an external object, for example a human being, can reach us, and none the less, the person in question is immediately and directly recognized by us as a human being. The process of recognition, therefore, never takes place in any schematic and automatic way, but always bears entirely a creative character.

In the same way as we immediately recognize a person unknown to us as a human being, we also recognize the identity of someone known to us, whatever the external situation. He is, whatever the orientation in space, directly and undoubtedly one and the same. His picture for us has been completed by bodily movements, which we call "characteristics", without their ever being carried out in exactly the same manner, and by his voice, although he scarcely ever says exactly the same thing, and by many other peculiarities. And in the same way, a table is for us a table, a tree a tree, a horse a horse, a triangle a triangle, without regard to the individual peculiarities of these objects, and their momentary arrangement and position. Here is a problem, which we generally overlook, since the facts just referred to are extremely familiar to us in our daily life, and hence appear self-evident. According to the point of view we are taking, this phenomenon must be regarded as follows : The recognition of an object or a certain person by ourselves does not take place additively from the sum of single peculiarities observed, but as a whole (in the terms used by W. Koehler and Wertheimer, as a *Gestalt*). I first grasp, therefore, the whole (the *Gestalt*) of the object presented to me, and only thereupon do I perceive

a greater or less number of single data, according to the degree in which I turn my attention to them. In the same way, I am myself, as object of my own observation, always in the first place an undivided whole, which is not originally, but only after a process of laborious intellectual analysis, perceived to be made up of a sum of single data.

We will now enquire whether our consideration of the subject will be furthered by the fiction that not only man, but also an animal, grasps itself and the objects of its surroundings as wholes. We take a spider's web, and destroy a part of it. If we do serious damage, the spider abandons the web; but if the damage is less serious it mends the injured part by drawing new threads in a manner adapted to the situation. It appears to me that we must here speak of the spider grasping the matter as a whole. For before we do the damage, it has produced a whole: its web. It recognizes, when we injure it, whether repair is worth while or not; in the first case it restores the damaged whole by addition of the required threads. We are not able to understand its intra-central situation, from which its sureness is derived without previous example and learning; we do not know whether the animal is conscious during the processes of spinning and repair at all, or if so, of what it is conscious. We have already seen that the question of animal consciousness cannot be attacked by scientific methods; but even if the contents of the consciousness of animals, in this case of a spider, were known to us, we should not be much further advanced. For even in the case of human beings, the deep psychology founded upon the doctrines

of Freud, Adler, Jung, Stekel, and others, has shown us that the contents of consciousness are often of least importance in deciding action ; much greater importance usually attaches to what exists on the other side—as it were—behind the conscious personality.

Just as, in our own case, our grasp of wholes comes out of unknown depths, just as it is given to us with compulsive necessity from the structure of our brain and intellectual organization, so also is the grasp by the spider of a whole inseparably linked with its whole nature. That so highly specialized a grasp of wholes should exist in an inborn form, without having been individually acquired, appears to us human beings extraordinarily strange. We are not able to understand it on the basis of our own organization, but are obliged to be content with simply registering the phenomenon.

The animal also recognizes other members of its species as wholes, in so far as it comes into relation with them. Thus, for the animal—as for man—the sexual partner, for example, is not a conglomerate of single data, but a complete whole, the parts of which must be put together in a certain way and not otherwise.

The *Gestalt* of the partner requires in some cases, to comprise not only a certain optical impression, but also a voice or peculiar smell, which plays a great part in the case of many animals. Stimuli produced by contact may also be of importance.

The first alarm which the animal receives of the presence in its neighbourhood of an enemy, a prey, or a sexual partner, may be given by single data of one of the senses : hearing, sight, smell, or touch ; on the other hand, the

way the new arrival is dealt with, the defence against the enemy, the attack on the prey, the act of copulation, is always a matter of the whole. There are certain kinds of animals which are wanting in one of the senses named, for example hearing or sight; but this by no means detracts from the wholeness of their reaction. The same is true of the blind or deaf human being. A blind man can only gradually form a conception of the shape of a body by feeling it; nevertheless, in spite of the fact that the tactual impressions are only acquired gradually, the final result is a conception of the whole body. For it is of no importance as regards the grasp of a whole, whether the sense data concerned are received simultaneously, or one after another, this is true, for example, of the spider, which does not take in its whole web at a single glance, but runs all over it and thus notices a certain defect. The case of the blind man is similar: he forms the impression of a body as a whole out of a set of separate tactual impressions.

There is even no obstacle to the fiction that the animal grasps itself as a whole, and it allows us to do justice to the fact that the activities of animals always bear the character of wholeness. Of course, we are not maintaining that the animal is conscious of itself as a whole; the matter of consciousness, as we have seen, has very little point in this connection. Deep psychology has taught us that the behaviour of a fellow human-being can be much more comprehensively grasped when we lay less stress upon what takes place in his consciousness, but rather neglect this to a great extent. When attempting to understand the behaviour of animals,

we may leave the question of consciousness entirely aside.

We set up the fiction that the hermit crab, for example, which in moving straight towards a lamp, turns its body now one way and now another in quite an irregular manner, is for itself, and to itself, a whole. Its body is the instrument which serves to reach its goal; it performs motion in a straight line while handling this instrument in the most various manner. Another example; a bird striving towards a goal by swimming, flying, and running in turn, is itself a whole; it is able to vary the means from one moment to another, while its action is determined by the goal.

In the foregoing we have imagined that we are able to understand the behaviour of an animal by sympathy. Here we are taking no account of the question whether the animal possesses consciousness and understands itself. In order to discuss this assertion more fully we must return to the question of how understanding takes place among human beings. One human being can very well understand another, without the latter understanding himself. This kind of understanding plays a great part in more recent psycho-therapy and teaching; thus the doctor, for example, may make clear to the patient the purpose of his neurosis, of which he has hitherto been ignorant. In many cases, therefore, the content of the consciousness of the person to be understood has in the first place nothing to do with the matter.

We must, however, remember that understanding is a completely subjective phenomenon; hence, several persons forming a judgment may, according to various

circumstances, understand and experience sympathetically one and the same person from different points of view, each depending also upon the inward situation of its possessor ; for every observer is dependent, as regards what seems important to him, almost entirely upon his own psychical organization. Thus the nature and character of understanding result not only from the nature of the being to be understood, but also from that of the one understanding , we need in no way assume misunderstanding, when one observer regards and experiences sympathetically the behaviour of a person more in one way, and another more in another way.

Furthermore, one person may understand another in the deeper sense, even when he is by no means clearly conscious of all the details of the latter's behaviour ; in fact, understanding is not in itself so much a matter of what is present in the consciousness of the subject. This allows us to suppose that an animal, also, is able to understand the behaviour of another animal, or that of a human being , and in this case, according to what we have just said, there is for the moment no need to take further into account what takes place, during the process, in the first animal's consciousness.

With this, the concepts of understanding and of being able to understand have acquired a fictional character ; the importance of this fiction lies in our being able, with its aid, to assert that human beings can directly understand animals, and that these may understand, on the one hand one another, and on the other hand human beings, though only within certain limits.

By way of conclusion, we will once more consider the

question whether wholes exist which extend beyond single individuals—super-individual wholes, as we may call them, of which the single individual forms only a part. When we observe various species of animals and plants in their natural surroundings, we see that they are adapted to these in the completest manner. We owe to von Uexküll very profound observations in this direction. According to this author, each species of animal selects from its surroundings what is biologically important for it, and capable of being grasped by its sense organs; only this is “environment”, or “the surrounding world” for it. And each species of animal therefore lives in its surroundings in a glass case, as it were. In the world of earthworms, there are only “earthworm things”; in that of the dragonfly, “dragonfly things”; in that of the dog, only “dog things”. If therefore two animals belonging to different species are in the same place, their relative environments may be completely different. The same is evidently true for human beings, where great differentiation exists according to race, social position, age, occupation, etc. It is well known “with what different eyes” a landscape, for example, is seen by a painter, a geologist, or a strategist; for each of these men, quite different features of the terrain are important and unimportant.

Legewie has pointed out that for one and the same individual animal, the surrounding world can be entirely different according to the physiological conditions in which it finds itself; thus the hungry animal has quite a different surrounding world from that of the satisfied creature, the animal before copulation a different one

from afterwards, etc. According to the inward physiological situation, various objects of the surroundings and of the surrounding world assume importance from time to time. The same thing is true of man ; not only in the course of his individual development, as child, adult, and in old age, does he form from the total environment quite different subjective surrounding worlds ; even at one and the same stage of development—even from hour to hour—various things assume great importance at one time, while at another they are completely unnoticed. In and out of the daily occupation, before and after meals, before and after sleep, in sickness and in health, the “ surrounding world ” has an altogether different constitution.

Are we then to describe the organism and its total environment, or such living and non-living things as it takes from the latter as important—the organism therefore and its relative surrounding world—as a super-individual whole ? Whether such a fiction proves useful or not, depends upon the special scientific purpose which we are pursuing. In the present case it does not seem to me correct to take this course ; the concept of super-individual wholes should be defined more narrowly when we are considering questions of animal psychology. For the organism is adjusted in the most exact manner to its environment, and fitted to live in it ; while the converse of this cannot be asserted. The environment in which we find organisms is constituted without any reference to the latter. The various positions therefore, in which animals and plants make their homes, the rocky cliff, the sea-coast, the prairie, and other localities, are for the

most part pure aggregations of certain characteristics, and not wholes in the very narrow sense in which we are using the word at present ; the reader may be referred in this connection to the first chapter. It is true that the individual animal grasps its environment as a whole, and deals with it in a unitary manner , but I do not feel justified in regarding such relationships between the organism and its environment as resulting in the formation of a super-individual whole. Hence we shall not apply this notion in all cases where the organism is, as it were, one partner, and the environmental aggregate of living and non-living elements, or that relative environment abstracted from it, the other partner. We shall only speak of a super-individual whole when two or more living organisms enter into relationship with one another. But not every form of such association is sufficient to produce a whole ; when animals meet at the same feeding place (for example, flies on a piece of carrion, cattle at a watering-place, etc.), this chance collection (conglobation, see Chapter X) is by no means enough to form a super-individual whole. In the same way, the struggle between an animal and its prey, or between two beasts of prey, does not result in the formation of a whole.

We shall confine the notion of super-individual wholes to those cases where the individuals show themselves during a relationship (which furthermore must not last for too short a time), to be linked to one another inwardly. Super-individual wholes in this sense are to be regarded as embodied in animal matings, animal families and animal societies, with which we shall deal more in detail in Chapter X. To go beyond this, and to apply the

fiction of the super-individual whole to all individuals belonging to one and the same species, is not a necessity in the present connection. A species might, however, be regarded as a closed procreative community of all its individuals, and thus be defined as a super-individual whole ; but we will not here make use of this possibility, but merely refer to it.

CHAPTER VIII

Primary and secondary knowledge,—Instinctive and experiential activity.

WE have already discussed at an earlier stage an important difference between man and animals, the difference, namely, that in many cases animals possess innately faculties which man must acquire laboriously. Many animals are able to run or swim from their birth; the spider spins its web without example or practice, the bird makes its nest, when the time comes, without ever having seen such a nest before. The caterpillars of many species of butterflies spin a cocoon shortly before the pupa stage; and this may have special arrangements which later aid the butterfly in creeping out. Examples of this kind can be multiplied indefinitely; they all have this in common, that the animals in question are able to exercise a certain activity without example and without learning, and in a perfect manner.

In such cases, therefore, we are not dealing with aptitudes for activity which have been individually acquired, but with those which have been inherited, at a given time—sometimes directly after birth, sometimes in the course of later life—the animal proceeds to exhibit behaviour characteristic of its species. The term instinct has been applied to this; a notion which has been the subject of much controversy. Many authors have demanded that it should be eliminated entirely as being

too "mystical". When, in the following pages, we speak of instinct, the reader is to understand nothing more by the term than an inherited aptitude for an activity; instinct shall be a symbolic term for a power hidden in the animal and manifested by it at a given moment

We will take as synonymous with the notion of instinct that of the drive; whoever desires to avoid the first word, may use the second. An activity set going by an instinct or drive is an instinctive or drive activity; it is contrasted with experiential activity, which is brought about by practice and learning. Such experiential activities play, as we know, by far the greater part in human life; practically nothing in the behaviour of the adult human being is inborn; he is obliged to learn almost everything

If we describe knowledge acquired by practice and experience as *secondary*, we may call the inherited aptitude for activity *primary* knowledge. The question as to whether or how far consciousness accompanies the utilization of primary or secondary knowledge is here pointless. We know from ourselves that there are actions which, once learned, we are finally able to execute without the need for our conscious attention. Walking and bicycling may be carried on without our consciousness having any part in their details. Our daily walk to our occupation, the winding of a watch, even the writing of the address on an envelope or the posting of the letter—all these are actions which, after they have been many times repeated, may be accompanied by so small a degree of conscious attention to them, that we may often be after-

wards at a loss to remember whether or how we performed them.

We will now enquire whether man possesses only secondary or acquired knowledge, or whether he may possess inherited aptitudes to activity, however narrow their limits may be. The new-born human being brings with him into the world the capacity for sucking and swallowing. This is something that he does not need to learn, but is able to execute from the first. Here we are therefore dealing with an inborn or primary knowledge, an instinct in our sense of the term, whereby we leave entirely out of consideration the extent to which the infant is consciously aware of itself and of its own action. Furthermore, the new-born infant possesses a peculiar grip reaction—obviously an ancient inheritance, which has largely lost its importance for present-day man. For our ancestors, this reaction was most certainly of importance, as it still is for apes today, for it leads to the infant taking firm hold of its mother.

An inherited aptitude to activity, which is first manifested in man in the course of his development, is that for sexual action and its preliminaries ; here we have a drive which gradually becomes more and more pronounced, an instinct, which leads to action of a quite definite character. Some authors have summarily declared instinctive actions to be unconscious ; but the last-mentioned example of a typical instinctive action in the case of man, shows without further question that " unconscious " and " instinctive " are not to be regarded as equivalent ; for no one will maintain that human action in sexual matters takes place without participation of conscious-

ness. But in other respects, inherited aptitude to activity is practically completely absent in the case of man ; but on the other hand, he has received a strong drive to accumulate secondary knowledge. The young child finds itself, as it were, in the position of an explorer who has landed upon a hitherto undiscovered island, and now finds everything, both as regards land and inhabitants, completely unknown and worthy of investigation. As the child's bodily development progresses, its mental horizon extends ; while its environment is at first almost without detail, it becomes, in course of time, continually more differentiated and rich. But in this process the child's grasp of its surroundings never proceeds by mere aggregation, but always as a whole : the world is first present to it as an undifferentiated whole, and only gradually do more and more numerous details begin to become prominent. Also, in all that the child learns by its own powers and efforts, the whole is present before the parts, as for example in learning to speak. At a certain age the child produces a series of sounds, which have similarity with sentences, but are entirely unarticulated ; primordial sentences, as I may call them. From these, sentences correct from the adult's point of view are gradually differentiated ; this process might be compared with the development of the complete individual from the embryo. The egg and the embryo are not merely a sum of single parts, but whole structures at every stage ; here, also, the whole is first present ; the ovum and later the embryo ; from these the parts, that is, the organs, are differentiated step by step.

In contrast to mankind, animals possess many inborn

aptitudes ; these form their primary knowledge. We may now ask whether or to what extent animals are also capable of acquiring secondary knowledge, and to what extent, therefore, they are able to acquire experience. We easily succeed in training both higher and lower animals in such a way that a biologically indifferent stimulus becomes associated in them with a biologically important one ; if the two stimuli are frequently allowed to operate simultaneously, they are linked together in the animal intra-centrally, in such a way that it finally reacts when only the biologically indifferent stimulus is given to it, which stimulus before training did not cause a reaction. The biologically important stimulus is called unconditioned, since it always and invariably produces a reaction ; the biologically indifferent is called the conditioned stimulus, since it is only responded to conditionally, that is to say, after successful training.

Bees can be trained to respond to certain colours, blue or yellow ; for example, they are given for a period their food, say sugar and water, upon a blue surface ; this finally leads to the individuals in question alighting upon every blue surface, whether food is present upon it or not. In the same way fish can be brought to visit only a vessel of a certain colour, for example, red, all other food vessels of different colour being ignored. It is necessary in this case to offer the experimental animal simultaneously a number of small vessels of different colours, and repeat this several times, whereby food is always contained only in one, namely, the red vessel. Fish may also be trained for sound ; if they are frequently fed while a sound of a certain pitch is given simultaneously,

they finally swim up when they hear this "food note", although there may be no food awaiting them. The number of cases in which animals can be trained to respond to biologically indifferent stimuli can be extended indefinitely. The cases of the bees and fish just mentioned were positive training, that is to say the experimental animal first reacted to the unconditioned, and then also to the conditioned stimulus, positively, by moving towards it. By way of contrast we have negative training, in which the experimental animal answers negatively, when the stimulus is offered, by moving away. We allow an earthworm to creep several times into the vertical limb of a T-shaped glass tube, when it reaches the two side arms it decides with equal frequency to go to the right or the left, as long as similar conditions exist on the two sides. We then close one arm, for example the left, to the animal, by introducing an electric circuit, so that the animal receives a shock every time it creeps into this tube. The earthworm very soon learns to avoid the left arm, and only passes into the right one. Similar negative training can be carried out on many other animals; an indifferent stimulus is always associated as the conditional stimulus with a punishment stimulus as the unconditional. Thus, for example, the cockroach will learn, like the earthworm, to move right or left to avoid punishment, in frogs a punishment reaction can be associated with certain colours, and so on. In other words, it is easy to prove under the simplified and clear conditions which can be set up in the laboratory that animals of the most various systematic groups are able to learn, that is to say, acquire secondary knowledge.

We find that in natural conditions also, animals store up secondary knowledge and make use of it in their later behaviour. Bees, ants, and other insects learn by experience to know the surroundings of their nests, so that they can find their way back from every direction. On the rocky coasts of various seas there lives, in the tidal region, the common limpet (*Patella*). Each individual of this species returns at every ebb tide to the same place, where it remains until the sea returns. At the flood tide it feeds upon the small algae of the surrounding rocks and then returns in good time—from any direction whatsoever—to its accustomed resting-place. It finds the way by reference to the peculiarities of its surroundings; if with a hammer and chisel the surface of the rock is changed, the animal is no longer able to find its old resting-place.

In other ways also, many animals are able to learn: they remember the place at which they have frequently found food. Particularly higher animals, such as birds and mammals, know exactly the spots at which they are harried, and where they are safe. Furthermore, ravens, for example, are able to distinguish a sportsman from harmless pedestrians; deer have become assured of the innocuousness of the trains that thunder past, so that when grazing they do not show the slightest signs of disturbance, whereas the approach of a single person will put them to flight. Higher animals kept in captivity distinguish their keepers from other people: sometimes they will only take their food from the former. We could bring innumerable other examples to show that in the life of animals, their individual and acquired experience

plays a part alongside their inherited aptitude for certain activities.

It has already been pointed out that we, from our human standpoint, are not able to enter into the inward situation of an animal which carries out, by inherited aptitude, some kind of complicated activity ; for example, that of the spider, when spinning its web or repairing it when defective. Power of this kind is almost miraculous to us. In such cases recourse has been had to the idea of instinct ; on certain sides something supernatural has actually been supposed to be at the back of instinct, and hence from other sides it has been looked upon with great disfavour. But let us consider a moment : is an inherited aptitude for an activity something more wonderful than the morphological structure of an animal's body and the interaction of the physiological processes taking place in it ? Are, let us say, the conception and development of the individual, and the continuation of its bodily functions, already " explained by science ", and only the inherited aptitude still " unexplained " ? By no means. All that I have just named are phenomena which refuse to yield up their inward nature to our comprehension : they are one and all equally well " known " to us or also equally " unknown "—both expressions are equally applicable in this context. The animal that possesses an inherited aptitude has not only inherited its various organs, but also instructions, as it were, for the use of them ; thus equipped, it has no need for trial and experience, but knows what to do from the very beginning.

Finally, the following further question arises : is the presence of primary knowledge more wonderful than the

power of man and animals to acquire secondary knowledge and to store it up? Here again, the answer is in the negative. For are we able to state in the least degree what happens, "how we do it", when we learn something? If the instinctive actions of animals appear particularly wonderful to us, the reason is to be found in the fact that in our own behaviour instinct plays a very small part; what we ourselves are accustomed to is the inherited organization and functioning of our own bodies, and the power of collecting experiences. Nevertheless, all this is by no means "better known" to us, as regards its nature and origin, than any inherited aptitude for activity. For a very simple reason. all knowledge of this kind exceeds our human capacity and our power of comprehension by far, not only now and today, but for all future time.

Hitherto I have set primary and secondary knowledge, or action from instinct and action from experience, alongside one another; and it might thus be imagined that these notions are to be taken as the expression of irreconcilable contrasts. We will now enquire whether—either in the case of animals or man—activities exist in which instinctive and experiential elements are both concerned. Let us return to the example of the power of bees and ants to return home: the instinctive drive is the impulse to swarm out, to learn by heart the surroundings of the nest, and then to return after each excursion; at each excursion and each return, however, individual experience must play a part, inasmuch as the animal is compelled to keep in memory the details of its surroundings. The primary part, therefore, is the know-

ledge that the nest must be left and then returned to again, while the details of the way in which this is to be effected are secondary knowledge. Furthermore, instinct and experience are mingled in all training; the search for, and consumption of, food depend in themselves upon primary knowledge, and are inherited aptitudes; but when the experimenter succeeds in training an animal to seek its food at a definite place or on a definite colour, experience is concerned in this behaviour as an important element.

In the various races of animals, the instinctive aptitudes are modifiable in varying degrees; the instincts—as it has been expressed—are “plastic” to a variable extent. There are instincts possessing great rigidity. A frequently quoted case in this connection is that of a bee (*Chalcidoma*) which lives solitarily. The female builds a number of combs, charges each with a definite quantity of honey, lays an egg in it, and closes it up. If we bore a hole in a comb while the female is engaged in filling it with honey, it investigates, it is true, the hole and the escaping honey, but does not repair the damage, but proceeds to bring to the comb the remaining quantity of honey, to lay its egg there, and to close the comb, without reference to the fact that the honey is flowing away. Here we see that the limits of a highly complicated parental instinct can be drawn very narrowly; we might suppose that the female would repair the injured comb immediately, since its bodily constitution renders it perfectly capable of doing so. But its central nervous organization is not prepared for this activity. The series: building the comb, bringing a measured quantity of honey, laying an

egg, and covering up the comb, is adhered to with absolute rigidity, with complete indifference to the fact—visible to an observer—that the continuation of the series of activities has been rendered senseless by a disturbing element from outside.

We have already mentioned as an inherited aptitude that of the bird for building its nest. At a certain time, namely at the beginning of pairing, the bird builds a nest in accordance with its species, even when it has not itself been hatched out in such a nest, and has never seen one. But experience may also play a certain part in nest building, in so far as an older bird which has already built several nests will do so with greater skill than a young one.

The drive of the male bird to sing is inherited, and even when the young male has never heard the song of another bird, it commences at a given time to sing on its own account. But such an animal remains a poor performer; and those males produce the most perfect song which have had an especially good example in an elder individual of their species. This is well known to breeders of canaries, chaffinches, nightingales and so on, and these give the birds they breed the best singers as teachers. Hence on the basis of a drive primarily present, that of singing, the form of the song in individual cases is determined by example and practice. It thus happens, for example, that finches in various parts sing differently; they have, as it were, in each case adopted the dialect of the neighbourhood. Mocking-birds are able to learn the song of various species of birds and also to imitate other noises, such as the

creaking of cart wheels. In other species, on the other hand, the young male under natural conditions always seeks out an elder male of its species as a teacher; what is therefore primary in his case is the knowledge as to what kind of song he is to choose as an example, and on this basis he builds up his own powers as secondary knowledge.

Care of the offspring is an inherited aptitude in the case of many higher animals; it corresponds to the pairing instinct of young individuals. These two drives are plastic to a large degree; hence, if we take a young bird or a young mammal away from the parents or the mother immediately after birth, and give it as a fosterchild to an individual of another species, it continues to follow the latter, and later no longer recognizes its own parents. Hence in this case there is no "call of the blood", any more than in the case of human beings. For the young bird, the human hand can take the place of the mother or the parents; if the young creature has been accustomed to it, it will seek refuge in the hand and avoid the parents. What is born therefore in the young bird or the young mammal is the need for protection; but this attaches itself differently, and to different objects, from case to case.

The instinct of the parents to care for the offspring is also plastic. Lloyd Morgan describes an extreme example. A hen three times hatched out young ducks. While on the first occasion it was somewhat upset when the young ducks immediately took to the water, it gradually became accustomed to this process with the second and third brood. A fourth brood consisted of her own offspring;

when these were hatched, the hen tried in all kinds of ways to persuade the young animals to enter the water, and even to drive them into it. In this case the normal instinct had become very greatly changed by habit.

CHAPTER IX

Instinct and experience in human beings —Behaviour indicating insight in man and animals.

It was shown in the last chapter that in human beings instinctive activities play a very small part as compared with those based upon experience. We mentioned sucking and swallowing in new-born children, and also their clutching reaction, as an example of inherited aptitude for activity; at puberty, the sex drive appears in a sharply defined form, after having already signalized its presence at an earlier age by various actions of a more diffused character

It was shown in the last chapter that, in the case of animals, actions based on instinct and on experience are not to be regarded as opposite in nature, since the two extremes are connected by numerous intermediate stages, in which the purely instinctive element, and that dependent upon experience, are both concerned in bringing about a certain activity. Let us now see how the matter stands in the case of man. When a child learns to talk, and to get into contact with its surroundings in other ways as well, what is primary in this activity is the inherited drive. The gradual accustoming of the child to its environment is only successful on this basis. If the social instinct is defective or perverse in its development, the individual in question is the victim of an endless chain of very difficult external and internal con-

flicts. We thus see that the child must bring with it into the world a certain general readiness to adapt itself more and more to the world as that world is constituted. In this case, however, it is not a matter of specialized inherited aptitude for activity, such as we find in animals, but simply the aptitude of its species to assimilate those experiences which are necessary for its existence. But, as we all know, experience alone is not by any means sufficient for life ; behind this experience must exist the drive to activity and to making use of experience in practice. This drive to act and to take part in active life, is something primary ; the secondary stored-up knowledge is simply a means of finding one's place in the world and behaving in a manner suited to the immediate situation. Hence, in every action which we perform upon the basis of our experience, there is a component founded upon instinctive drive ; and great individual differences exist—it is a “ matter of temperament ” as we say—in the way in which experiences are made use of.

Activities in which, even in the case of adults, the drive component is immediately evident, are the absorption of nourishment and the sexual act. But even in these, secondary knowledge plays a part. There are very great variations as between one race, and one grade of society, and another, in the matter of when and what is eaten, and what is rejected ; and even in the sexual act, the importance of experience and custom cannot be denied.

A higher rank still must be assigned to actions based upon insight, than upon those based upon experience. What is common in these two forms of behaviour is plasticity, but whereas in the case of experiential activity,

there is a previous stage of trial, practice, or learning, it is characteristic of behaviour based upon insight—apart from a short period of latency which may occur—that there is a lightning-like grasp and comprehension of the situation. Experiential action and action based upon insight, are not opposites, for the latter may be regarded as experiential action of a very shortened character. Observation of ourselves teaches us how numerous are the intermediate stages between activities which can only be exercised after long trial and practice, such actions as depend upon the solution of a problem being perceived by us directly. The intermediate stages are formed by activities which are preceded only by a short period of trial, or in which the period of trial becomes transferred to a mental process; and we are also no doubt justified in assuming that, in all behaviour based upon insight, earlier experience of some kind plays a part.

It must further be said that any behaviour in which a complete solution is not arrived at also frequently depends upon insight. For the word "insight" is not used in the sense of a judgment of values, but merely to characterize a certain type of behaviour in which the outside world has to be dealt with. We each know from our own experience that there are innumerable stages between insight which immediately leads to a true solution of a problem, and complete want of understanding of a situation. Matters are further complicated by the fact that between the observer and the person observed there may be a difference of opinion as to whether a complete solution of a problem has been obtained or not; the person observed may be subjectively of the opinion that

the problem was solved; whereas the observer may maintain that it was only partially solved. All conceptual difficulties of this kind disappear when we require as the criterion of insight, not insight in a valuable sense, but only a certain form of prompt reaction, which allows of complete solution and also of partial solution.

It would be completely erroneous to contrast activities based upon experience or insight with instinctive actions by calling them "voluntary actions", for our will also takes part in setting in motion drive actions such as feeding or copulation; the organs in question send signals to our brain, and the will impulse then results accordingly. How the will is formed in special cases of this and similar character is completely impenetrable, and must always remain so. Whether our will is in any sense "free" (in the sense of indeterminate) cannot be decided. We are subjectively of the opinion that we act freely after conscious consideration of all motives, when, for example, we decide whether we shall go to a concert or not; or we may believe that a writer has complete and conscious freedom as to whether he will have one of the characters in a play die or not. Recent medical psychology maintains, however, another opinion (see for example, Kretschmer). According to this school of thought, the motives which determine whether, to take our example, we visit a concert or stay at home, may never reach our consciousness at all; and when the writer works out his play, nothing in it is freely formed, or even a matter of chance, but on the contrary, the whole work and all its parts are definite and unambiguous forms of expression of its author's whole psychical make-up.

We know nothing of the part played by consciousness in our own psychical processes. It certainly plays a part in those activities which we describe as our "highest"; in trial, practice, learning, consideration, and in the attainment of insight and so on. But how we manage to arrive at a certain insight, how we try out something or learn something, and how we put our experience into practice, are matters which we cannot describe. We have too strong a tendency to experience everything taking place in consciousness as constituting our "self", and to ignore the unconscious. But without the latter, consciousness could not exist at all; it would be entirely without any root and foundation. In the case of man there are experiential activities which must first of all be learned and practised consciously, and can then be carried out without consciousness playing any part in them; I refer to cycling, winding up a watch, etc. Actions of this kind are called "acquired automatisms". It would be entirely erroneous to regard them as equivalent to instinctive activities. In the case of instinct, we are dealing with primary knowledge, inherited aptitude for activity; acquired automatism, on the other hand, is secondary knowledge.

Finally, we may refer to a further misuse of words. Occasionally, instinctive activities on the one hand, and extreme experiential activities, and also behaviour based on insight, on the other hand, are distinguished as "unconscious" and "conscious" actions. From all that we have said above, this distinction is not allowable. For in the case of mankind, the degree of consciousness may vary greatly without any reference to the relative

part played by instinctive and experiential elements in certain activities. And in the case of animals, the distinction between conscious and unconscious activities is ruled out entirely, since we know nothing whatever concerning their consciousness.

"Inborn ideas" do not exist in man. He brings into the world the aptitude for acquiring in a continually increasing degree, in the course of his individual development, concepts and abstractions ; a definite morality or a definite idea of God are no more born in him than are, for example, the concepts chair, tree, horse. He simply possesses the aptitude for acquiring such concepts relating to his environmental conditions as are brought to him by his fellow-men. He further possesses the aptitude for absorbing the moral and religious standards which are valid in his environment. Or as Jung expresses it somewhat differently : "Morality is not forced upon us from outside, we have it in ourselves *a priori*—not the special law and the single rule, but morality as such." If mankind possessed inborn ideas, they would be matters of highly specialized primary knowledge—a primary knowledge such as the spider, for example, would possess concerning her web, if she were conscious to the same degree, and in the same manner, as man.

Human concepts and ideas are based upon primordial aptitudes for reaction, which are also shared by animals. A large object moving quickly, an approaching beast of prey, will cause many animals to take flight or assume a defensive position ; it is on this basis that man has developed the concept of "enemy". A young chicken does not yet know the difference between what is edible

and what is not ; at first it pecks at every small object, at an inkblot on the ground, and at its own toes. It only gradually learns to distinguish between what is food and what is not. On such a basis as this, man has built up the abstraction " food ". We owe to the psychiatrist Sommer the following important observation. In the case of mankind, we have cases of medium feeble-mindedness, in which abstract concepts are completely absent ; nevertheless a patient of this kind possesses a direct understanding for the things in his environment, a certain practical sense, which enables him to carry out, for example, all sorts of household duties. Sommer concludes that understanding—and insight—must be possible in the absence of abstract concepts. This is of importance in the present connection.

Behaviour based on insight, that is to say the instantaneous grasp even of an entirely new situation, has been observed in the case of a number of the highest vertebrates. Among these we have the investigation of W. Koehler and Kohts, on chimpanzees, Yerkes on gorillas, Bierens de Haan on one of the lower apes (*Cebus*), and Hertz on ravens. All these investigations were carried out with the strictest method and accompanied by critical examination of the results. We may hope that investigations of this kind will be continued, especially with reference to such animals as dogs and parrots. In this connection it is of importance always to bear in mind that the various species of animals live each in a specific " surrounding world " (in von Uexküll's sense), and therefore that human things are quite different from dog things or

parrot things. Hence we never do full justice to a dog when we require it to open doors or learn to choose different colours, and then deduce its capacities from such tests. On the contrary, it is necessary to set it problems which actually belong to the dog world, to a dog situation. The corresponding case is given when pigeons, for example, are caused to run in a maze ; an experiment of this kind can never enable us to find out all the possibilities hidden in this animal. A maze has a much closer correspondence with the environment of rats or mice, and it is quite clear how different rodents and pigeons must be from one another by reason of the completely different kind of organization of their particular environmental world

Lovers of animals are very fond of discussing the question as to whether, or how far, animals exhibit behaviour based on insight ; particularly, of course, their own animals. The lover of animals generally tends to overestimate their powers, he looks upon inherited aptitude as insight, but his worst mistake of all is to humanize in a naïve way animal behaviour, and to overlook the fact that the surrounding worlds of his dog, his cat, and his canary, are quite different from his own.

A special form of behaviour based on insight, the use and construction of tools, is met with in apes. The chimpanzee is capable of turning a stick into an instrument for acquiring a fruit lying outside the bars of his cage. W. Koehler has observed that some of the animals kept by him were able to push one bamboo into the end of another one, or even to add to this a third, when one stick alone was too short for their purpose ; if the ends

of the sticks did not fit one another at first, they were gnawed by the teeth until it was possible to fit them together. Two or three boxes were piled one on the top of another, in order to reach a fruit attached to the roof of the cage.

If the fruit was outside the cage and beyond reach, Koehler observed chimpanzees, and Yerkes gorillas, to throw all sorts of objects, even straw, for example, in its direction, and thus set up a connection, no matter how useless, between themselves and the goal. On account of the insuperable external difficulties, the apes' problem, that of reaching the fruit, could not be solved; and not only for the observer, but also obviously for the animal, the throwing of objects towards the fruit was merely a substitute action and not a solution; this could be deduced from the animal's whole behaviour—or in the sense of our present mode of expression: it could be understood sympathetically.

"Tool" is a quite general term for an object external to the body, and used by man or animal in addition to their own organs for carrying out any activity. According to this definition, the weaver ants living in Ceylon also exhibit the use of tools. These animals build nests in trees by a number of workers each seizing a larva of their own nests, and sticking the leaves, laid together by other workers, by means of the secretion of the larvæ. The larva may thus also be described as a tool, for it is something external to the worker's body, which it uses in addition to its own organs for spinning. This form of the use of tools is, however, something quite different from that of the apes. For in the case of the ants, we

are dealing with an inherited aptitude for activity, with primary knowledge, born in every worker ; there can be no question of activity based upon insight in this case. But in the use of tools and in the construction of tools by apes, insight plays a part ; for these forms of activity are not inborn, but may arise spontaneously in a suitable situation as individual variations in behaviour.

CHAPTER X

Animal sociology.—Superindividual wholes: marriage, family, society, in man and animals.

WE said in an earlier chapter (VII) that mating, family, and society should, in the case of animals, be regarded as superindividual wholes. Obviously, the fiction of a whole can be extended to cover other cases in the organic world, according to the purpose in hand. For example, the totality of plants found in a definite limited space may be described as a whole, for between the single individuals of the same and different species living alongside one another, the most various reciprocal relations exist; and these relations are not solely in the form of mutual competition, but may also involve exchange of material and hence be regarded as of mutual advantage (see Zimmermann). The botanist calls such communities of plants, in which one individual is dependent upon another and stands or falls with it, associations. It is a problem for plant sociology to investigate all the relationships occurring between plants. We are also able to take into consideration the animals which inhabit a certain locality, together with the plants; then again we may speak of wholes, for on the one hand animal life without plants would be impossible, and on the other hand, the plants are influenced in the most various ways by the presence of the animals. Wholes of this kind are called *biocoenoses*; according to the nature of the soil, climate,

and other external factors, they are entirely different in their composition. A pond, a section of river, a mountain range, and so on, all possess their characteristic biocoenoses; the investigation of biocoenoses is called biocoenotics.

In the present connection, however, we will limit the concept of superindividual wholes to animal mating, animal families and animal societies.

These wholes are the problem of animal sociology (see my book with this title, published in 1925). The three forms we have mentioned of animal association deserve special mention here because they take effect simply as the result of factors which operate in the individuals concerned from within. Monogamic animal mating for example, is the name given to the phenomenon that one male and one female unite and live together for a longer or shorter time; in the case of many birds, the two partners thus united remain so for life, that is to say, the mating does not cease at the end of the pairing season, but persists over the period of sexual rest; this happens in the case of ravens, parrots, birds of prey, etc. It is not external compulsion that keeps the animals together. For what in all the world could lead the two partners to remain together not only during the sexual period but also during the asexual, if not their own instinct to set up such a union; the instinct for monogamic mating?

The same is true for the animal family and animal society. No external power could compel a pair of birds to take care of, to guide, and to defend their young; on the contrary, the drive to carry out all these functions

acts upon the two animals from within them, and quite directly. The parental instinct of the parents corresponds to the instinct of the young to attach themselves; the drives possessed by the single individual thus lead to the animal family becoming a superindividual whole; these drives may be summarized as the instinct to form families, which exhibits itself in the case of the individual members, father, mother, and young, each in a specific manner. There likewise exists an instinct for social aggregation, which in the case of fish, birds, and mammals, for example, attaches the individual animal to the flock or herd. And this instinct causes the individual to become restless and even to waste away, when it is separated from all connection with its own kind.

Mating, family, and society of animals may be summed under the term "true societies". We must distinguish them sharply from those chance aggregations which are the result, not of an inward instinct, but of some external factor. Writers term them *associations* as contrasted with *societies*, and hitherto I have followed this terminology. But it has led to many difficulties, above all because in plant sociology, an *association* is the term given to a number of individuals connected with one another physiologically in the closest possible manner, whereas in animal sociology, the term association has hitherto been used to describe a collection of animals brought together in one place by some external factor or other, and remaining there for a longer or shorter time without any relation to one another. It appears to me, therefore, desirable no longer to call such chance collections of animals associations, but to give them a new designation,

and I propose to apply the term "conglobation" to them.

Collections of insects coming together at night around a lamp are conglobations. A single individual does not come there to associate with the other animals, but is attracted by the external factor alone, the light; and this attracts each animal without any reference to the others. Other conglobations are collections of flies and other insects on a piece of putrid meat, of green-fly on a twig, of cattle around a watering-place. It is therefore always an external factor which brings the animals together at the place in question, and they never come together there on account of the other animals. It is at first only a conglobation which results when we bring higher animals, for example birds or apes, together in a cage, or when children are collected in a school class, recruits in a squad, travellers in a railway carriage, as chance brings it about.

Whether continued existence of animals in a conglobation results in the development of a society depends upon the organization of the particular species. There are animals which are entirely incapable of entering into any kind of relationship with other individuals, or at the most those of attack and defence, and now and then the sexual act. Such animals we may call *asocietary*. In their case, every individual lives for himself, without any reference to whether it is alone or in the neighbourhood of others of its species. The lower animals, beginning with the protozoa, are throughout *asocietary*, and it is only in the highest animals that we find species, the members of which can form relations with one another.

Such species we called *societary*. Among invertebrates (molluscs) we may mention the cuttlefish (cephalopods), among the insects those that live in "states" (bees, ants, and termites), and finally among the vertebrates we have particularly birds and mammals. But even in the latter classes there are *asocietary* species, for example the cuckoo and the marmot.

The use of the designations *societary* and *asocietary* enables us to avoid the words *social* and *asocial*. Hitherto it was common to speak of social insects and social animals, and of social relationships between individual animals; it was then frequently necessary to deal with the double meaning of the word *social*. For in its human application this term has two senses, namely one free from any reference to value, in which it merely states the presence of some kind of relationship between different persons; and on the other hand one implying value, in which the different forms of relationship are divided morally into higher and lower. On account of this double meaning, the word *social* has proved unsuitable for animal psychology.

If *asocietary* animals are brought together at one place, the conglobation remains such, however long it exists. This can be easily shown by bringing, for example protozoa, flies, or any kind of worms together in a vessel. If, on the other hand, we are dealing with *societary* animals or human beings, which are of course *societary* by nature, the most various relations soon arise between the individuals concerned; the conglobation thus becomes a society. We can observe this at once when a number of fowls or other birds, or apes, are brought together in

a cage. In the same way, men and women brought together by chance soon set up innumerable bonds of relationship, and if sufficient time is allowed, the single individuals develop into a society.

I have already said that it is a task for animal sociology to deal with animal mating, animal family, and animal society. Occasionally the question is raised whether it is permissible to speak of such a thing as animal sociology. This objection has been raised by professional sociologists of a philosophic type of mind. It appears to me that this view is based—to put it crudely—upon an overestimate of mankind and an underestimate of animals. It was supposed that the institutions of human marriage, family, and society had come about by rational thought and resulting agreement of opinion. But if this latter idea is pursued to its logical conclusion, marriage, family, and society in mankind actually appear as business or economic undertakings. This leaves out of account altogether the completely irrational element which drives the individual human being at a given time to unite with another, to found a family, to take care of the progeny in the most self-denying manner, and also to unite with other human beings to form a society.

The objection can be made that marriage, family, and society appear in the most varied possible forms in different races and in different sections of society, and that in marriage we have, along with monogamy, polygyny, and as a rarer variation, polyandry; hence it may be said that a common denominator cannot be found. Whoever argues in this way overlooks the fact that behind all these phenomena there is the primary drive

to form marital, family, and social connections, and to fulfil the demands resulting from such connections. This societary drive is—like most other drives in human beings also—very plastic, and thus may find expression in the various forms according to the environment into which the individual person is born. But it must be always present as a foundation, since otherwise marriages, families, and societies, would never come into existence in any form at all. When in a given person the societary instinct is ill-developed, whether as regards marriage, family, or society, the most severe conflicts are inevitable and it is generally not the case that the person in question fails in only one of these three respects, but equally in all of them. If, therefore, I were asked “Are we dealing in human marriage with a business arrangement, or with a mystery?”, I would answer, “Rather with the latter”; for it appears to me that the irrational element is far more concerned in marriage than the pure question of mutual arrangement. The same is obviously true of family and society.

We have to imagine that in the far distant epoch when man grew up psychically beyond the animal world and became what he is today, marriage, family and society already existed, and when man then began to reflect about himself, all he could do was to sanction these already existing institutions by rational considerations formed afterwards.

We will now return to the question whether it is permissible to speak of animal sociology. We see that in many animals, a single male mates with a single female and this connection may last their lifetime; such indi-

vidual association of the two animals with one another I call monogamic animal mating. We have here the same drive which leads a pair of human beings to remain together for their lifetime for better or for worse. Hence in man and animals, monogamic mating rests upon the same basis; only in the case of human beings, their much wider psychical development allows them to develop the relationship between the two partners to a much more differentiated degree. When in animals a male collects several females around him—just as in many races a man may marry several wives—we may call this polygynic animal mating. While in some species of animals the instinct for monogamic connection is characteristic, in others we have an instinct for polygynic alliances.

Monogamic or polygynic mating of animals lasts either during a reproductive period only, when we may call it short period or seasonal mating; or the individuals in question remain associated for a longer period and even for life, and this we may term permanent mating. The following distinction is also of importance. When the individuals which have mated separate from their fellows of the same species, we may speak of solitary mating; we speak of societary mating, on the other hand, when the mates live together with others in flocks or herds. Polyandry is rare in the animal kingdom; when it occurs, it is always connected with the female sex being considerably large physically than the male.

So far, nine different categories of animal mating have been distinguished.

(a) Polyandric, solitary, seasonal mating. Polyandry

occurs only in the case of certain invertebrates. In the case of the sea-worm *Bonellia*, for example, up to twenty dwarf males associate with every female, and live in her proboscis; in certain spiders, two males mount the female, and repeatedly perform the sexual act.

(b) Monogamic solitary seasonal mating. In many species of beetle, a single male and female remain together for a summer; the same is true of many fishes and frogs and in these cases both parents, or one at least, may also take care of the progeny. Many birds and all beasts of prey pair monogamically afresh at the beginning of each reproductive period.

(c) Monogamic solitary permanent mating. This form of mating is characteristic of many birds. The pair remains together even during the sexless period. It is also found in the case of the orang-utang and probably in the various species of rhinoceros.

(d) Monogamic societary seasonal mating. In this category we have many birds which build their nests in colonies, for example swallows, in which the pairs may remain together only for one nesting, and change their partners for the next.

(e) Monogamic societary permanent mating. Strict monogamic and lifelong pairing is found in the flocks of many birds, for example certain parrots. The existence of monogamic pairing within the herd is now also proved in the case of the gorilla.

(f) Polygynic solitary seasonal mating. This form of mating, in which the male lives with a harem only during the reproductive season, and separate from others of its

species, is found in buffaloes, elephants, many species of deer, antelopes, wild sheep, and wild goats.

(g) Polygynic solitary permanent mating. Here also the male remains together with his harem for a longer time, but likewise apart from others of his species; examples are the domestic fowl, the fuanao, the vicuna, the primitive wild horse, the zebra, the wild ass, the kangaroo, and the macaco.

(h) Polygynic societary seasonal mating. In many species of seals, for example the American fur-seal, the male collects around him a harem for the duration of the reproductive season; sometimes numerous males with their harems are assembled at the same place. At first furious fighting for the possession of the females occurs among the males, until a gradual mutual recognition and limitation of interests is brought about.

(i) Polygynic societary permanent mating. In the herds of many apes, for example the baboon, we can discern an organization of this character; each adult male, of which several or even many are present in a herd, collects a harem about him. The constitution of a harem remains unchanged for a considerable time.

The animals united with one another monogamically or polygynically maintain their unions more or less faithfully; here we have both specific and individual differences. Monogamy is strictly maintained among cranes, swans, and geese; in other species of birds, unfaithfulness occurs from time to time; we then speak of accessory promiscuity. We must distinguish sharply between two forms of promiscuity: promiscuity as a normal thing, no mating at all occurring in the species in question; and

accessory promiscuity occurring in many species alongside mating. This latter form is, as we know, not uncommon among mankind ; but in spite of earlier statements to the contrary, promiscuity as a normal thing is known to us neither in any past nor any present-day race. Among birds and mammals we have, alongside many species in which mating regularly takes place, a few species in which mating is regularly absent ; in these, therefore, promiscuity is normal. Such species are the game-fowl, North American cattle-bird, cuckoo, bat, bison, hare, quail, and pheasant. In the case of black-cock and capercaillie, the relations of the sexes approach promiscuity.

In the case of many lower animals living in water, no individual sexual relationships whatever exist, both male and female discharging into the water their sexual secretions, the ova being thus fertilized. In many lower animals sexual union takes place, but the sexual act is repeatedly or frequently performed in a quite unordered manner, between animals of opposite sex, so that promiscuity is normal. But the further we ascend in the zoological system, the more frequent become the cases where an individual alliance of shorter or longer duration occurs between the sexual partners, whether monogamic or polygynic ; in other words mating takes place.

The animal family arises from animal mating, when the individuals in question remain together for a time. According as both parents or only one remain with the offspring, or as the offspring alone remain together for a time, we distinguish the parental family, paternal family, maternal family, offspring family.

We may describe as animal societies the shoals of fish and flocks of birds and herds of mammals; many also of the invertebrate cephalopods form shoals. Chief of all, we have the "states" of bees, ants and termites (see von Frisch and Escherich). In societies of birds and mammals, monogamic associations and families may take part, and many animal societies consist solely of individuals united by mating and by family relations. Mating of the latter kind has already been termed societary.

According to the period of duration of animal societies, they may also be divided into classes. We have temporary societies in the wandering swarms of locusts and dragonflies. These animals are as a rule solitary, and when a number of them are found together, we are confronted with a conglobation. However, a drive to wander may suddenly arise in several individuals together, they fly away in a closed swarm, and on their way attach all members of their species to them. But sooner or later, this nomad society breaks up again. Seasonal societies are of somewhat longer duration; they remain together during a year. Many birds and mammals live together in societies only during the annual sexual rest period, whereas in the reproductive season, each monogamic or polygynic family separates from the other members of the species (the first form is found in many migratory birds, the latter in the nandoo and Indian buffalo, for example). Others live in societies for the whole year, but the structure of these varies greatly from one season of the year to another; for example, the herds of the fur-seal consist in the reproductive period of males with their harems, while in the period of sexual rest males and

females live in separate herds. Permanent societies may be formed both by animals exhibiting seasonal rutting, and also by species which are permanently capable of sexual union (for example, rodents living in colonies show seasonal rutting, and are monogamic; whereas many apes are permanently sexual; the gorilla being monogamic, the baboon polygynic). Every such society, therefore, is constructed of a number of monogamic or polygynic matings, and their offspring. A peculiar form of permanent society is that of the "states" of societary insects (ants, bees, and termites).

It is always inward compulsion and inhibition, which regulate the living together of animals, in mating, families, or societies. The supreme principle is not naked force; this only plays a part when irreconcilable differences occur. In animal society there is in no sense a state of confusion, either in sexual, or in any other respect, the same being of course true of aboriginal society. Let us take as an example a flock of nesting wild or tame pigeons. These animals live monogamically, nevertheless accessory promiscuity occurs, inasmuch as the sexual partners are occasionally unfaithful. It would be a complete mistake to explain the maintenance of monogamic relations between pairs of these birds merely on the basis of general want of opportunity for unfaithfulness. For a societary organization can never be durably founded on such external chances, even an organization such as that of pigeons. The most important requisite is always the inward predisposition of the animals concerned to a definite attitude, their inherited instinctive reaction towards the external world. This is, of course, supported

by many accessory factors, such as fear of the sharp beaks of other paired pigeons, intensive occupation with nest building and care of the offspring. But the primary thing is the monogamic pairing instinct.

In the foregoing, we have described the three forms of society : mating, family, and social organization, as super-individual wholes, while we are of course at liberty in other connections to set up the fiction of other super-individual wholes. We selected mating, family, and society, for the reason that they result from individual association which does not depend on chance or external compulsion, but is governed by a drive, operating from within. As members of a society, the individuals in question become as it were parts of this new whole, and their behaviour can only be understood when we take into account their relation to this whole.

CHAPTER XI

Spontaneity and attention —Understanding and communication.
—Emotion and emotional transference.—Personal familiarity —The will to superiority.

WE have seen in earlier chapters how greatly the behaviour of animals is dependent upon internal physiological states ; for the hungry animal, a piece of food has the character of a goal, and is striven after with every available means ; after hunger is satisfied, food has lost its actuality and remains unnoticed. The same is true for all other things in the animal's world , hence we are justified in saying that one and the same individual lives in a completely different world according to its physiological state. This rule may be immediately transferred to mankind. We must further add to this that the animal's world may change not only from within the individual , by the addition or removal of a single thing, it may be completely altered at a stroke. For the individual grasps its outside world, not additively, but as a whole, so that every single thing in it interacts intensively with every other. The appearance of an enemy, for example, fundamentally transforms the surrounding world. Suddenly, some things lose their actuality, whereas others become of importance for avoiding or fighting the opponent. The same is true of the disappearance of food or of the sexual partner ; hitherto indifferent things are made part of the external world, if they are able to serve the restoration of the original state

of affairs. A peculiar type of surrounding world is that in which the goal striven for is for the moment absent. For example, the bee, acting upon its primary knowledge, seeks flowers ; and if, when it is away from the hive, we remove the latter some distance away, it seeks it on its return in the old position

Regarding the matter from the point of view of the final result, and in the fictional sense, we may speak in both these cases, of a " search " for a thing of the external world which is not yet perceived, without reference to whether anything corresponding thereto exists in the bee's consciousness. Other animals also search, in many cases, for a goal outside their immediate perception, whether it be one that has not yet come within the range of their sense organs, or one that has subsequently been lost by some chance or another.

The behaviour of animals is not decided alone by physiological states which the observer can directly determine, such as hunger, satisfaction, capacity for pairing, fatigue, and so on ; there is something else present in addition which we must describe as spontaneity. Activity occurring spontaneously cannot be regarded merely as something happening by a release effect ; it is therefore not a newly appearing external factor which causes the change of behaviour in such cases. The whole internal situation may lead to the gradual ripening of an impulse to exclude or relax some activity or another, so that a change in behaviour is produced without external influence.

It was a fundamental mistake of earlier authors to assume that the animal is " the slave of its surroundings " or " of its sense organs "—as it was expressed—and was

thus obliged to follow every sensual stimulus. On the contrary, sense impressions are only guides to it. In certain cases of course, the intra-central attitude of an animal may be decisively influenced by an external factor, for example an enemy, or by an inward physiological factor, for example hunger or want of air. But apart from these and similar causes, an animal may act spontaneously in a manner which cannot be predicted. An animal may run away, fly, or swim up, spontaneously, that is to say, without any change in its surroundings. Whether, where, and when it lies down to rest are also decided in the first place by its spontaneity.

Hence the sense impressions which the animal is continually receiving are always followed conditionally only ; spontaneity may lead an object to suddenly assume the character of a goal, and finally likewise to lose it again. This brings us to the problem of attention. It is true that biologically important factors, such as food or enemy, may be able in many cases to attract attention. But beyond this it is spontaneity which decides in the case of animals, whether anything in their surroundings shall acquire actuality or lose it ; the direction of the attention towards any object is not a reflex process, but a higher intra-central act.

We know in the case of man that a change in the external situation may have the most varied effects, such as acceleration of the pulse, palpitation, perspiration, blushing, trembling, even hair standing on end, and the like. These physiological processes are the peculiar forms of expression of internal agitation. Along with these, we may have movements of certain groups of muscles, such

as those of the face, the arms, legs and so on. Furthermore, in the case of man, we may have tears, laughter, whistling, or even song. All these things may take place as simple forms of expression, for example, even in the absence of other persons. If a second person is present, he is able to understand the psychical situation of the first by observing the forms of expression. This frequently happens without the first individual having produced these forms of expression with the object of bringing about understanding with the second. Finally, we have the case when forms of expression are used as a means for effecting an understanding with a fellow-creature, and hence with the object of mutual understanding.

We have thus defined three possibilities: 1. The form of expression appears without its reaching or being intended to reach another person. 2. It is produced without reference to a second person, but is nevertheless grasped and understood by one. 3. It is intended to be understood, and to bring about mutual comprehension.

In the case of mankind movements of the larynx may also be forms of expression, and these lead in the simplest case to expressive sounds having no conceptual meaning. Sounds of this kind have led to the formation of human speech. Such a thing as conceptual speech does not exist in the case of animals, but mutual understanding may nevertheless be brought about between them; only, however, among the highest species. Many animals make use of the tail as an organ of expression; this is easily observed in the case of the dog, the squirrel and others. If any object of interest, such as a piece of food, or a member of the same species, appears within the sphere

of observation of such an animal, its tail may exhibit lively motions while its body remains still. The intra-central excitement "flows off" in this way, it is prevented from being dammed up, as has been said. Similar discharge of excitement is seen in the case of a person who taps with his fingers on the table, when any other reaction is for the time unavailable. The tail wagging of animals which we have mentioned is a form of expression produced without reference to other animals: but how far others are also able to grasp and take notice of it, requires further investigation. Human beings at any rate take it as a quite definite signal when a dog approaches them wagging its tail. Other forms of expression found in animals are sounds of various kinds; the song of birds also belongs in this category. A bird may sing without a member of its own species being in the neighbourhood; it is then a matter merely of the discharge of intra-central excitement, such as occurs in connection with the general enhancement of life phenomena at the pairing period. But the song may also serve to establish a relationship between male and female, for it may be the means of rivalry between two or more males. Many forms of expression of animals such as hissing, snarling, barking, erection of the feathers or hairs, are taken by other animals as a warning signal. In all these forms of expression we are dealing with inherited, that is, instinctive, reactions, and the alarm and recoil produced by them is also instinctive. Whether or how far experience may also take part in such defence and repulsion probably varies from case to case.

Other forms of expression are the strokes of the antennæ

which the individual ant gives to another ant ; this " tickling " transfers specific states of excitement from one animal to another, so that definite activities are incited, such as feeding, search for food, common attack, flight, etc.

Many birds and mammals emit a sound at the approach of an enemy, and this sound is taken as an alarm not only by members of the same species, but also those of other species. For example, the so-called warning cry of the jay causes all animals in the wood to start. The jay by no means cries with the intention of warning the remaining creatures in the wood ; but the expressive form of the cry is taken as an important signal. In the latter case, experience plays a decisive part. The reaction to the jay's cry is not unborn ; the animals living in the wood have learned to connect danger with this cry (a biologically indifferent stimulus has become associated to them with an unconditioned stimulus), and this secondary knowledge is then carried over from one generation to the next by the example of the parents.

Inviting sounds are to be regarded as aiding mutual understanding ; finches, for example, when passing together through the wood, make continual sounds, which serve to hold the whole flock together. Bodily movements of the most varied form may be applied to bring about mutual understanding between members of the same species ; thus every species of ape possesses sounds, lip signs, bodily gestures and movements, peculiar to it, and used in intercourse with its kind. And when an imprisoned dog howls until its master comes and frees it, there can be no doubt that this form of expression, howling, is not

produced merely as such, but with the object of communication with its master.

The excitement which is behind these forms of expression we call *emotion*. The forms of expression are often characterized as over-emphasized reactions, since there is an over-production of movement and sound. The stronger the emotion, the stronger the over-emphasis—at least this is true in the majority of cases. We have seen earlier that affective expression is often without importance as regards the relationship of the individuals to one another. In other cases, the affective expression becomes a signal for another individual, and on this basis mutual understanding may come about. An emotional storm brought about by its interaction with the surrounding world may often be of biological value to an animal, for example, when it is a matter of defending itself from an enemy or overcoming its prey; but in other cases a storm of this kind may also be a danger to the individual's life, as for example if it is led to attack an opponent too powerful for it, or if it falls into a panic.

In the case of asocietary animals, other individuals enter their surrounding world only temporarily, as enemy, prey, or sexual partner; otherwise, they remain excluded. In the case of the members of societary species, the part played by other individuals is quite different; societary animals are only capable when united to their fellow-members of the species, of developing all their inherent possibilities. Societary animals may enter into mutual relations with exhibition of strong emotion. Primary knowledge causes one animal to recognize another as a member of its own species. If one dog meets another,

its whole surrounding world is changed at a single stroke, its emotional reaction brings the fellow-member of its species into the centre of attention, and causes the most various forms of expression to appear. Primary knowledge allows the young chaffinch to recognize the older male as a suitable example for learning to sing, and to set its muscles in motion in a proper manner.

Likewise on account of primary knowledge, the human child of a few months of age is able, for example, to pout its lips, and make other movements of the face when these are shown to it by an adult. Here we have between two human individuals, the child and the adult, a completely direct kind of contact ; the adult is not able to state in words " how he does it " when he pouts his lips, much less is the child able to do so ; inherited primary knowledge guides the child in imitating with its own organs an example given to it.

The child also possesses an inborn resonance for affective expression ; according to an observation by Bleuler, a boy of five months already recognized the meaning of being laughed at. In this connection, we may also remark that all animals, including the anthropoid apes, are completely and finally devoid of any understanding of laughter, which is a specifically human form of expression.

When two human individuals enter into mutual relations, not only the spoken word, but also something much more direct plays a part. Look and gesture are required to give the words the necessary relief, and often even words are unnecessary to bring about understanding and sympathy. Sympathy as well as antipathy usually arise on

the basis of such direct relationship, and less as the result of a conversation. Animals, for their part, do not possess speech in any form; nevertheless the members of societary species are capable of understanding one another, and this always comes about, in absence of words, by motions and sometimes by the emission of certain sounds. In this way alone, in the case of animals, individual friendships and enmities are also set up, and the sexual partners become associated in monogamic or polygynic mating.

Geiger says that in the case of societary animals, members of the same species are directly recognized as comrades.¹ This sense of comradeship may be deepened between animals which are more closely united with one another, such as mates, parents, offspring, or members of the same herd. In the "animal friendships" frequently described as existing between members of different species, we have this sense of comradeship also existing. The same comradeship may also be set up between man and dog, or man and ape. The further removed from one another in their whole organization two species are, or in the case of man, the further the animal is removed from his own species, the less can the other individual be felt as a person, and the more it becomes an object.

In flocks of finches, the most various species are found together and recognize one another mutually, as social partners; in the herds of African big game, we find various species of antelope, and even zebra and ostrich;

¹ The German is *du-evidenz*. This is untranslatable in English. It means "obviously entitled to be addressed with the familiar thou".

in the case of ants we have mixed colonies, where two or more species are found together. But, as we have already said, when the difference in organization is too great, a limit is set to the formation of societies made up of different species.

The emotions bring the individuals of societary species in mutual relation to one another. Emotional expression of a suitable character produces frictionless interrelation, while unsuitable emotion leads to disharmony. An emotion is transferred easily from one individual to another. This accounts for the infectious character of many activities, the barking of a dog will set all the dogs in the neighbourhood barking; one bird taking to flight may sometimes cause the whole flock to follow its example. Emotions also play a decisive part in the relationship between human beings. A completely emotionless action—as far as such a thing is possible—will scarcely lead anyone to imitate it; a statement made unemotionally possesses infinitely less power to move than one accompanied by motion.

In the higher animals, the comradeship between members of like species finds its expression in their very strong affective reaction to the specific cry of fear or warning; furthermore, it is not unusual for the sight of a dead individual of the same species to produce strong emotion. Thus it is possible to keep ravens, for example, away from a fowl-run, not only by means of a scarecrow, which imitates a human being (however crudely), but also by hanging up a dead raven.

In the mutual relationships of animals which are in a more or less friendly relationship to one another, a part

is played not only by mutual help, but also by mutual injury. Here we may find the manifestation of a force to which our attention has been particularly drawn by Adler's Individual Psychology: the striving for power or superiority. Schjelderup-Ebbe has made extensive investigations concerning the order of rank which is always set up in societies of birds and mammals. One individual is always the superior and one the inferior. The greater the number of individuals forming a society, the more differentiated may such a system become. Nor is it brute force alone which decides who is to be the superior; it may be simple arrogance, and above all a peculiar bearing, which gives an individual animal superiority from the beginning. The striving for superiority may take the most various forms. Apes often show a tendency to unexpectedly pull the tail or hair of a comrade. In Koehler's experiments, one of the chimpanzees piled two or three boxes one upon the other in order to reach some suspended food; while he was then working on the top of this structure in a precarious position, the other unoccupied chimpanzees would sometimes creep behind his back and upset the whole erection, together with the animal, by a powerful push, and then run away at great speed. At times, it would become the fashion with Koehler's chimpanzees to throw sticks at the fowls. The fowls would either be simply attracted, or even actually fed, with bread, and then be suddenly poked violently with a stick; this game might be played by two chimpanzees working together, one feeding the fowls and the other tormenting them.

Schjelderup-Ebbe describes in the case of the wild duck

a game of a sexual character, which depended upon the deception of several males by a female. The wild duck lives monogamously, and this union is, generally speaking, very strictly adhered to by the female. A mated female was seen to fool several unpaired males on various occasions, by flying towards them, only to fly away to safety in good time, as soon as they began to run after her.

The following case in which an individual ape, itself unquestionably inferior in position, attempted to acquire a certain superiority, is reported by Yerkes. In a cage, a younger ape was accustomed to set its comrades against one another. The animal behaved as if it had been attacked by another ape; as soon as this resulted in the elder apes quarrelling, it ran away and observed the further course of events from a secure position.

CHAPTER XII

The human being as investigating subject, and object of investigation

IN this concluding chapter, we will once more deal with human beings. I have often had to mention them before, and I believe that we have been able to show very many traits common to man and animals. I do not of course intend to eliminate the difference between man and animals; the zoologist is perhaps of all men the most familiar—almost daily and hourly in fact—with the line of division between animals and man. But we must not forget, by reason of the differences, what they have in common; and it must be especially stressed here that man can never be completely understood as a "spiritual being"; if no account is taken of the fact that he is conditioned by, and bound to, nature, he easily becomes for the investigator a ghost and a phantom.

When we take human beings as organisms among many others, we arrive at the fact that the knowledge which they are able to collect can never have absolute, but only relative, value. As von Uexküll has shown, every animal exists in its own surrounding world as under a glass globe. The same is true of human beings; every person, indeed, has his own surrounding world, which is conditioned by his physical and psychical organization. The objects constituting this world for one person are not necessarily objects forming part of the world of another.

To make a comparison ; objects reflected in mirrors of various curvatures and colour exhibit various kinds of images, and every mirror is "right" according to its own nature.

In this book I have put forward the view that we human beings are only able to grasp the world by setting up certain fictions. I must leave it to the reader to decide whether he will follow this view or not, or will demand from science doctrines which claim to be absolute. Furthermore, this decision also is a question of the psychical structure, and of the psychical needs which spring from it. Without doubt, that person is subjectively happier who sets up a rigid system of firm opinions as absolute truth.

Concerning this notion of fictions, we may also make the following further remarks. A fiction is a construction which brings into connection with one another various kinds of processes or things in a manner which enables us to think about them. A fiction is sometimes an image which serves to make a thing more picturable. A judgment as to whether the imagined connections really exist, frequently lies entirely outside the limits of our powers. The concept of a fiction, therefore, is stated here in a somewhat different sense, than in Vaihinger's philosophy of "As If". For this author, fictions are also "consciously false assumptions, which are either in contradiction with reality or even in contradiction with one another". Fictions of this kind may prove to be useful in other branches of science, for instance mathematics, but are not suitable to the present connection.

But in course of this book the reader may have perhaps

noticed another mode of expression, which almost has the character of a fiction in *Vaihinger's* sense. I spoke frequently of the "higher" and "lower" animals. In the former class we placed those more similar to human beings than those we placed in the latter. Man describes himself as the highest form; from the point of view of human nature, as we know it in daily life this is readily comprehensible. To be able, and compelled, to select experience appears to man as a characteristic of a high rank; but how would the position appear from the point of view of the ant or the spider? These animals receive at birth, in the form of primary knowledge, everything that they need in the way of powers, for the rest of their life.

As compared with so rich an inherited endowment, might not man's want of primary knowledge be actually regarded as a lower characteristic? At the beginning of the system we place the protozoa, since they consist only of a single cell. Is it not also possible to maintain the view that those organisms are the highest in which a single cell is able to exercise all the functions of life, whereas in the case of multicellular animals, millions and milliards of cells must be combined together to produce the same effects by a division of labour? When therefore, we have spoken here of higher and lower animals, we are simply making use of conventional expressions, which have the advantage of brevity.

I have already said that it is simply a question of psychical need which decides the fiction set up by an investigator. Nature only answers those questions which we ask her; indeed, she only gives the observer those

answers which he expects from her. The interpretation of what happens in the case of man or animals is thus a matter of the psychological structure of the observer ; the psychical quality of the individual scientist is responsible for the nature of the surrounding world which he builds up for himself ; it decides what things and processes are invested with actuality in it, and what are ignored as unimportant. Furthermore, every variety of world view can be linked with the results of our observation in nature. Thus mechanists and vitalists, for example, may actually use the same experiments to serve as " proof " of their views.

It is a strange thing that controversies such as that between vitalism and mechanism are possible at all. The defenders of these two points of view appear on the scene with a claim to absolute validity for their doctrines, and overlook the fact that they are dealing only with fictions which each is opposing to the other. Driesch, one of the most eminent vitalists of our time, is a true child of the period in which he received the directive stimulus for his life ; he is a rationalist exactly like his great opponent, the mechanist Roux. The method of thought of both is rationalist, Driesch believing that the irrational can be grasped by reason. Driesch's four proofs of vitalism will doubtless appear to a later time much the same, as today the proofs of God's existence found in older theology and philosophy appear to us.

Causality and finality are therefore nothing but two fictional aspects ; purely causal views in biology stress the strict succession of events, whereas the *finalist* view takes the events of the living world from the point of

view of the whole, and makes the fiction of some "end" in the statistically determined final result. Causality and finality are not something read off from natural events in the "external world", but have been put into it by human beings, as a result of the need for the recognition of an order.

The causal law also, which is by the way not denied by present-day vitalists, is also a fiction. It cannot be proved in the strict sense, for this would require us to know all natural processes which have ever taken place, are taking place, and will take place in the world. Nevertheless, the law of causality is, on the one hand, a psychical necessity for us, at least, in so far as non-living nature is concerned; and on the other hand, we have no alternative but to assume such a law, since otherwise all our scientific and technical endeavours would appear meaningless from the start.

The fact that we exist, and are just as we are, is a fact which lies for us entirely in the irrational sphere. We have received a number of drives, in general of an extremely plastic character, which compel us to develop our psychical organisation at the same rate as our physical; these endeavours of ours are connected with ideals, which were the subjects of our choice. Let no one say that persons exist who are devoid of ideals. It is true that not everyone strives after ideals approved by society, of a humanitarian, occupational, or similar nature; but there exist ideals of a very different character, formed as the result of peculiar internal and external situations. Everyone has some ideal, some goal, after which he strives openly or secretly; everyone must

clothe his affirmation of life in some form. Nothing else is allowed by the drive which operates in the individual.

Not only is the beginning and end of our existence irrational, but also its whole course. Those who see in the fundamentals of human life no problem at all, are able by the aid of the facts which have been learned by experience, to "explain" all sorts of things rationalistically, and may even finally be led to the idea of solving "the riddle of the universe". Only, they overlook the fact that all fundamentals are assumed as existing, and hence the real problem is entirely set aside.

Our existence cannot be understood purely from the point of view of biological utility. Rather do we see everywhere irrational drives at work, which drive both individuals and also whole groups again and again to new plans and deeds. Inventions are not made because definite needs exist, which have to be satisfied, but inversely: first we have the invention, and only later does the possibility of practically applying it appear. Thus the microscope, for instance, was for centuries an instrument used by amateurs, who devoted themselves to observing the minute without reference to practical purposes; it was only in our day that it has become an indispensable instrument for the physician. The same may be said of all other inventions. The steamship and the railway were rejected when first introduced. The telegraph and telephone were not invented because it had been found that humanity could not get on without them; after decades of investigation by physicists without any useful object, the moment came when practical utility was seen to be possible; but the public was com-

pletely indifferent to the first attempt to introduce the telephone. We may finally mention two inventions of most recent date ; the aeroplane and airship. Here no one will maintain that they were created because it was impossible to get along without them.

At the back of everything that man undertakes we have therefore the drive which imperatively demands activity. It is true that our occupation serves the purpose of breadwinning ; but this useful purpose is not in the first place decisive as regards occupational activity ; much more important is the presence of the irrational drive to form something, build up something, and to carry it on continually. It is thus that business, industry, and agricultural undertakings come about, thus the general creates his army, the statesman, the writer, the scientist, do their life's work. The irrational element is particularly evident in the activity drive of the artist and of those interested in religion. Religion no more serves a purpose than does art , art is not intended to give pleasure, to elevate, to amuse, or whatever other banal purposes may be ascribed to it ; it is a form of expression, in which the artist clothes his inmost experience, and here and there his work of art then meets with human beings who are able sympathetically to understand his form of expression, and feel within themselves an inward resonance to it. In this way, a work of art is able to bring about an inter-individual relationship by the transference of emotion.

It is not the accomplishment of just sufficient to carry on life, but overproduction, which has an emotional and pleasurable tone ; this is true both of the occupational

as well as for other spheres. Dance, games, and sport have not been invented to provide human beings with recreation, but have originated as forms of expression of the activity drive immanent in man. We are able to observe the gradual development of this drive in the case of every child ; it is manifested in new ways as the child develops from stage to stage, in learning to walk and talk, in playing, and so on. Regarded causally, the child's play appears simply conditioned by the physiological and psychological factors operating in it ; regarded finalistically—taking therefore the state of the adult as the fictional " goal "—play serves as practice for future behaviour.

In this book, we have set up the fiction that man and animal are related in nature, so that conclusions can be drawn from one to another regarding their life processes. The plants also could be drawn into this community of nature. At the same time, the world of organisms was contrasted with non-living nature, peculiar laws being assumed for the living world ; a psyche-like agent was imagined as responsible for the phenomena of life exhibited by the organism. In the present connection, it was sufficient to ascribe to each single individual such an agent ; it was not necessary to form the fiction of super-individual, or collective, psyche-like agents, which could be manifested in society. Now plants, animals, and man form an uninterrupted developmental series of forms. How far it may be advantageous to assume psyche-like agencies as responsible for this continual further development, or philogenesis, will not be discussed here ; we may only refer to the possibility.

We cannot speak of a plant psychology. We certainly set up the fiction that a psyche-like agent is behind the life phenomena of plants ; but the latter are not able to execute bodily movements, such as occur in endless variety in the case of animals and man. These movements are what form the object of animal and human psychology. The observer is only able to draw psychological conclusions from the form and degree of motions which he observes ; expressive movements and sounds of all kinds, as well as human speech, belong to this category.

CONCLUSION

WE may now shortly summarize the main points of what has been said

In this book we have made use of the view that human beings are compelled to set up fictions in order to comprehend themselves and the world surrounding them. It is not given to us to attain absolute knowledge, but only that which is adapted to our sense organs and our mental organization. Furthermore, the nature and character of "knowledge" depends in the first place upon the psychical nature of the "knower". We take as fictions all natural laws, including that of causality, the assertions of mechanism and vitalism, the doctrine of the freedom and non-freedom of the will, and so on.

In the foregoing we have made use of the fiction that life events, as opposed to processes taking place in the non-living world, follow special laws; not, however, in the sense that life infringes physical and chemical laws, but that its special laws are built up on the latter as a foundation. It was further assumed that man and animals obey the same laws as regards their bodily and psychical processes, although they manifest themselves to us differently in their details.

Our psychical organization allows us to grasp not only ourselves, but also the surrounding world, as a whole. Only afterwards do we break up our surroundings into

single things, and as regards the things individually, the whole is again present to us before the part. Likewise, in the case of our own actions, the whole is given before the parts. In order to grasp the organism and its activities, we have made use of the fiction "the wholeness of the individual"; we assumed as super-individual wholes, both in the case of man and animals, mating, family, and society.

The observer collects statistical experience as to how certain modes of behaviour or bodily processes usually take place in man and animals; on the basis of this knowledge, the life process appears to him under the form of the fiction that the whole determines the parts, and the end determines the means. Here the "whole" is the course of bodily development or of a certain activity, as predictable by the observer, and the "end" is the final state. In the non-living world, there is no whole and no end in the sense of the words as here employed.

We may further set up the fiction that in organisms there exists, behind the whole life process, a psyche-like agent. Our consciousness would then be that region in which this agent is able to grasp itself. The question as to the consciousness of animals is insoluble. It has also declined in importance, as recent medical deep psychology has taught us, that in the case of man, the contents of consciousness often do not determine the ultimate action.

In grasping the behaviour of a fellow-human being, we have to distinguish between the methods of "understanding" and "explaining". The first takes place as a process of direct sympathy and comprehension, the latter depends upon experience and statistics. The

physician, for example, is sometimes able to understand a neurotic, even when the latter does not understand the aim of his neurosis, and hence does not understand himself. Hence the process of understanding does not always depend upon the conscious mind of the person understood. Hence, under the fiction that man and animals are allied in nature, we may make use of the understanding and sympathetic method, along with the explanatory, in animal psychology. On the other hand, one person can understand another directly in the more comprehensive sense meant here, without necessarily being clearly and sharply conscious of his behaviour. Hence in understanding, even the actual content of the understander's consciousness does not always play the chief part.

Leaving out the question of consciousness, we have set up the fiction that the animal also grasps itself and the peculiarities of its surroundings as a whole. Direct understanding is possible between animals: the more distant the species of two animals, the more difficult is understanding. Between man and animal, mutual understanding is also possible within limits. But man is often excluded from such understanding of animal behaviour because much in the animal takes place on the basis of inherited aptitude for activity (instinct, primary knowledge), whereas man, for his part, is obliged to acquire by experience, as secondary knowledge, practically everything.

The inherited and instinctive element exceeds by far the experiential, in most cases of animal behaviour. Instinctive and experiential activity are not sharp con-

trasts, but extremes of an endless series of intermediates. For many instinctive actions are not completely rigid, but in so far plastic as they are capable of individual modifications based upon experience. On the other hand, even in the case of man, every experiential action contains some element of the instinctive.

Behaviour based on insight is found, apart from man, in some of the highest vertebrates (for example, ravens and apes). In actions based on insight there is also always an instinctive component ; modern deep psychology has the credit for pointing out the part played by instinctive drives in human behaviour.

BIBLIOGRAPHY

- ADLER, A., *The Practice and Theory of Individual Psychology*, trans. by P. Radin, London, 1924. A 4th German Edition was published in 1930.
- ALVERDES, F., *Neue Bahnen in der Lehre vom Verhalten der niederen Organismen*, Berlin, 1923.
- ALVERDES, F., *Social Life in the Animal World*, trans. by K. C. Creasy, London, 1927.
- ALVERDES, F., "Die Frage nach der Ganzheitlichkeit in der Verhaltensweisen der Tieren," *Biologia Generalis*, Vol. 7, 1931.
- BIERENS DE HAAN, J. A., "Werkzeuggebrauch und Werkzeugherstellung bei einem niederen Affen," *Zeitschrift für vergleichende Physiologie*, Vol. 13, 1930.
- BLEULER, E., *Die Psychoide als Prinzip der organischen Entwicklung*, Berlin, 1925.
- BUDDENBROCK, W. v., *Grundriss der vergleichenden Physiologie*, Berlin, 1928.
- BUDDENBROCK, W. v., "Tropismen," in Gellhorn's *Lehrbuch der allgemeinen Physiologie*, Leipzig, 1931.
- DRIESCH, H., *The Science and Philosophy of the Organism*, 2nd. Ed., London, 1929.
- ESCHERICH, K., *Die Termiten oder weissen Ameisen*, Leipzig, 1909.
- ESCHERICH, K., *Die Ameise*, 2nd. Ed., Brunswick, 1917.
- FRISCH, K. v., *Aus dem Leben der Bienen*, Berlin, 1927.
- FREUD, S., *Introductory Lectures on Psychoanalysis*, trans. by Joan Riviere, London, 1922. Later German Edition, Vienna, 1930.
- GEIGER, TH., "Das Tier als geselliges Subjekt," in *Forschungen zur Völkerpsychologie und Soziologie*, Vol. 10, Leipzig, 1930.

- GROOS, K, *The Play of Animals*, trans by E L Baldwin, with Preface and Appendix by J. M Baldwin, London, 1898.
- HEMPELMANN, F., *Tierpsychologie vom Standpunkt des Biologen*, Leipzig, 1926.
- HERTER, K, *Tierphysiologie*, Vols. 1 and 2, Berlin and Leipzig, 1927 and 1928.
- HERTZ, M, "Das optische Gestaltproblem und der Tierversuch." *Verh. der Deutschen Zoologischen Gesellschaft*, Vol. 33, 1929.
- JENNINGS, H. S, *Behaviour of the Lower Organisms*, New York, 1906.
- JORDAN, H J, *Allgemeine vergleichende Physiologie der Tiere*, Berlin and Leipzig, 1929
- JUNG, C G, *Das Unbewusste im normalen und kranken Seelenleben*, 3rd Ed, Zurich, 1926
- JUNG, C G, *Psychology of the Unconscious*, trans by B M Hinkle, London, 1921
- KAFKA, G, "Tierpsychologie," in *Handbuch der vergleichende Psychologie*, Vol 1, Munich, 1922
- KRETSCHMER, E., *Medizinische Psychologie*, 3rd Ed, Leipzig, 1926.
- KRETSCHMER, E, *Physique and Character*, trans. by W. H Sprott, London, 1925.
- KOEHLER, W, *Die Physischen Gestalten in Ruhe und im stationären Zustand*, Brunswick, 1920.
- KOEHLER, W, *Gestalt Psychology* (trans), London, 1930.
- KOEHLER, W, *The Mentality of Apes*, London, 1929.
- KOHTS, N, *The Mind of a Chimpanzee*, Psyche Miniatures, London, 1925
- KÜHN, A., *Die Orientierung der Tiere im Raum*, Jena, 1919.
- KÜHN, A., "Phototropismus und Phototaxis der Tiere," in *Handbuch der normalen und pathologischen Physiologie*, Vol. 12/1, Berlin, 1929.
- LEGEWIE, H, "Organismus und Umwelt," in *Forschungen zur Völkerpsychologie und Soziologie*, Vol 10, Leipzig, 1931.
- LOEB, J, *Forced Movements, Tropisms, and Animal Conduct*, Philadelphia and London, 1918.

- MAST, S., *Light and the Behaviour of Animals*, New York, 1911.
- ROUX, W., "Das Wesen des Lebens," in *Kultur der Gegenwart*, Part III, Section IV, Vol. 1, Leipzig and Berlin, 1915.
- SCHJELDERUP-EBBE, TH., "Die Despotie im sozialen Leben der Vögel," in *Forschungen zur Völkerpsychologie und Soziologie*, Vol. 10, Leipzig, 1931.
- SOMMER, R., *Tierpsychologie*, Leipzig, 1926.
- STEKEL, W., *Psychoanalysis and Suggestion Therapy, their technique, etc*, trans. by J. S. Van Tealaar, London, 1923.
- UEKKÜLL, J. v., *Umwelt und Innenwelt der Tiere*, 2nd Ed., Berlin, 1921.
- UEKKÜLL, J. v., *Theoretical Biology*, trans. by D. L. Mackinnon, London, 1926.
- VAIHINGER, H., *The Philosophy of 'As If'*, translated by C. K. Ogden, London, 1924.
- WERTHEIMER, M., *Drei Abhandlungen zur Gestalttheorie*, Berlin, 1925.
- YERKES, R. M. and A. W., *The Great Apes*, New Haven, 1929.
- ZIMMERMANN, W., "Pflanzensoziologie," in *Forschungen zur Völkerpsychologie und Soziologie*, Vol. 10, Leipzig, 1931.

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